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Identification of RRII 400 series clones of *Hevea brasiliensis* in the early growth phase

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Abstract

The recently evolved hybrid clones of RRII 400 series viz., RRII 414, RRII 417, RRII 422, RRII 429 and RRII 430 of parents RRII 105 and RRII 100 have shown an average yield improvement of more than 20 percent over RRII 105. Among these, RRII 414 and RRII 430 were released for cultivation in 2005 and the others are in the pipeline. The present study was undertaken using one year old field plants with the objective of facilitating the identification of these clones recommended for commercial cultivation. Qualitative morphological traits viz., leaf characters including leaf stipule, leaf scar, shape of the leaves and pattern of venation were recorded. Results indicate marked distinction between the clones with respect to morphological traits. A combination of specific traits could be used for identification of each clone. Leaf characteristics of RRII 414 shows a close affinity to the female parent RRII 105 while RRII 429 and RRII 430 shows more resemblance to the male parent RRIC 100. The remaining two clones viz., RRII 417 and RRII 422 were intermediate for these characters..

Key words: Hevea brasiliensis; RRII 400 series clones; clone identification; qualitative morphological traits

Introduction

The Rubber Research Institute of India has recently developed a few high yielding rubber clones of RRII 400 series viz., RRII 414, RRII 417, RRII 422, RRII 429 and RRII 430. These clones are a result of hand pollination carried out in 1982 between the high yielding, widely accepted clone among the planting community, RRII 105, and a clone of Sri Lankan origin, RRIC 100. These clones have shown a yield improvement of 15 to 30 per cent over RRII 105 in various evaluation trials and exhibit better secondary attributes (Licy *et al.*, 1992; Licy *et al.*, 2003; Saraswathyamma *et al.*, 2006)). Hence, all the five clones were included in the Category III of planting recommendation of the Rubber Board in the year 2001. Realizing the promising yield potential of these clones nucleus quantities of bud wood were supplied to growers since 1997. RRII 414 and RRII 430 were released for commercial cultivation in 2005 and the other promising clones will be released in a phased manner.

Selection of planting material in *Hevea brasiliensis* should be judicious due to the fact that rubber is a perennial crop with a gestation period of seven years and the productive period is extends beyond 25 years. Every year, large quantity of planting material in the form of bud wood, budded stumps and polybag plants are required for replanting and new planting. Majority of the growers depend on private nurseries for procuring quality planting material. The growers are now facing serious problems in ensuring the authenticity of their planting material especially due to the fact that the new hybrid clones are of the same parentage. There are instances where complaints of supply of spurious planting material by commercial rubber nurseries have been brought to the notice of the Rubber Board either by the law enforcement agencies or farmers (Mercykutty *et al.*, 2002). Hence an attempt was made to elucidate the discriminate morphological features of RRII 400 series clones in order to facilitate easy identification from the nurseries and field grown plants.

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Materials and methods

Polybag plants and bud wood nurseries of the five clones *viz.*, RRII 414, RRII 417, RRII 422, RRII 429, RRII 430 along with RRII 105 and RRIC 100 established at the RRII experiment station in Kottayam and one year old field plants from small holdings near Kanjirappally, Cheruvally and Thiruvamkulam were selected for the study. Detailed morphological observations on foliar characters *viz.*, shape, separation and density of leaf storey; nature of axillary bud and leaf scar; characteristics of leaflets like degree of separation, shape, texture, symmetry, and margin; nature of pulvinus; shape, size and orientation of petiole and petiolule and nature of venation was recorded. Photographs of the field plants was taken with Olympus OM 10 Camera.

Results and discussion

Morphological observations on leaf storey, node, pulvinus, petiole, leaf lamina and pattern of venation were recorded. The terminologies suggested by Dijkman (1951) and Mercykutty *et al.* (2002) were followed for the description. The morphological patterns observed for each descriptor are given below.

Leaf storey (whorls)

Healthy and disease free plants with three-four primary whorls of mature leaves were preferred to plants having one-two whorls for a proper assessment of leaf storey.

Shape: Shape of the stories can be observed if the plants are viewed from a distance. They commonly exhibit four different shapes viz, bow shaped, hemispherical, conical and truncate. If the storey resembles a segment of a sphere, it is called bow shaped; when it looks like half of a sphere, it is hemispherical/globular; when the leaf storey resembles that of a cone, it is conical; when it appears as if the top portion is cut off straight across, it is called truncate.

Separation: Leaf storeys are separated from each other by bare stem (Figs.1a, b) Different clones show differences in the pattern of separation of leaf storeys. In some clones, differentiation between two successive whorls is comparatively less pronounced, whereas, in others they are well separated. Diffuse distribution of leaves in between successive whorls, i.e. stem bearing leaves over its entire length, is also rarely noticed.

Leaf density: Some clones have a relatively dense distribution of leaves in each whorl, while others are sparsely foliated (Figs.2a, b). If the leaves are crowded so that light does not easily penetrate through the storey, it is called closed. On the other hand in a sparse distribution light penetrates easily through the leaf story, it is called an open storey.

Axillary bud

Appearance: Some clones have dormant (inactive) buds, which are sunken into the bark while in others they are protruded (Figs.3a, b).

Leaf scar

This is the mark left over after leaf shedding. Leaf scars are normally flat while in certain clones they may have pronounced margins or protuberances (Figs.5a, b) Shape of the scars may vary from heart shape to circular (Figs.4a, b).

Leaf let

Separation: The leaflets are well separated in some clones owing to the wide angle at the point of attachment of petiolules to the petiole. In other cases, the angle is so narrow that the leaflets touch or even overlap each other.

Shape: Shape of leaf blade is characteristic of each clone and is least affected by external factors. Middle leaflet of mature leaves are best suited for describing this trait The shape is determined by (i) the proportion of length and width (ii) location of maximum width and (iii) the way in which the leaf blade tapers into its base and apex. Three basic forms of leaf shapes are distinguished. They are elliptical, obovate (pear shaped) and diamond elliptical. Elliptical leaf blade has maximum width in the middle, and tapering equally towards base and apex. If maximum width is found between the middle of leaflet and apex, it is considered to be obovate or pear shaped. Diamond elliptical is the diamond shaped variation of the elliptical form.

Base: Cuneate, attenuate and obtuse types of leaflet bases are commonly found (Figs.7a, b, c). Cuneate leaf base appears triangular, with the narrow end at the point of attachment. Attenuate base is long and shows a gradual tapering. In obtuse types, the base is blunt and rounded in shape.

Apex: Leaf apex is an equally important characteristic for identification of clones. Four types of leaf apices are commonly found *viz.*, aristate, acuminate, cuspidate and apiculate. If the apex tapers to a very

narrow elongated tip showing a stiff bristle like awn, it is said to be aristate. Acuminate tip refers to an acute apex, sides of which are somewhat concave and tapers into a prolonged point. When the apex is somewhat sharply concaved and constructed into an abrupt ending, it is cuspidate. If the leaflet is characterised by a short tip, then it is called apiculate (Figs.8a,b,c).

Symmetry of leaf blade: In general, leaves are symmetric. Asymmetry of leaf blades is observed in certain clones.

Margin: Margins are either smooth or wavy. Wavy margins can be further differentiated as regularly or irregularly wavy. In the former, all the curves are uniform, while in the latter they are having varying lengths.

Texture: Leaf texture may be either smooth or leathery, sometimes with uneven surface. It can be felt by touching the leaf blade. The texture is easily modified by climate. In dry season, texture of the leaflets becomes tougher or more leathery compared to wet season.

Thickness: Clones exhibit variation regarding thickness of leaves, which ranges from thin to thick. Thickness can be judged by gently feeling the leaflets between the fingers.

Pulvinus

Pulvinus is the slightly enlarged basal end of petiole.

Shape: In certain clones, the pulvinus is found to be swollen. Sometimes the swelling may be only at the base giving a spoon shaped appearance(Figs.9a,b).

Petiole

Lower leaves of the storey are the best suited for observing petiole characters.

Shape: Petiole shape falls into four categories *viz.*, arched, straight, concave and 'S' shaped. When the basal portion is shaped like an arch it is called arched and if there is no bending or curving, it is straight. If the middle portion of the petiole forms adownward curve, it is considered concave. 'S' shaped petiole has a convex bend at the basal portion and an upward bend at the distal end (Figs.10a,b).

Size: The petiole of some clones are long and slender or it may be relatively thick.

Petiolule

Orientation: The orientation of the petiolule may be upward, downward or horizontal with respect to the plane of the petiole (Figs.11a,b).

Angle of separation: The angle between the leaflets is said to be narrow or small (Figs.14,15) when the angle is less than 30°; if it is between 30- 70°, then it is considered to be broad or large. Relative length of petiolule can be long, medium or short (Figs.6a,b).

Petiole-Petiolule Juncture

Appearance: Swelling/striations may be observed in the juncture on the adaxial surface of some clones.

Venation

Colour of veins vary from light green to light yellow or yellowish green. This may be modified by external factors like light intensity. Prominence of veins shows clone to clone variation. Venation may be either normal or prominent in certain clones.

Intramarginal venation: Intramarginal venation is very prominent of some clones (Figs. 12a, b).

Lateral veins : Certain clones exhibit numerous lateral veins whereas few well separated lateral veins are noticed in some clones.

Morphological features of polybag plants and one year field plants are more or less similar. Hence, the categorization of clones given below is confined to young plants in the field (Table 1).

Identity of high yielding clones of rubber is of utmost importance considering the perennial nature of the crop. Attempts towards identification of different *Hevea* clones based on morphological traits have been reported earlier from different rubber growing countries (Jayasekera *et al.*, 1984; Delabarre and Binigno, 1994). In India, a comprehensive documentation of clone identification from 24 popular clones have been reported by Mercykutty *et al.* (2002). Detailed investigations to characterize the RRII 400 series clones based on yield and desirable secondary attributes have shown that distinguishable phenotypic and genotypic variations do exist among them, even though they are the progenies of the same parental combinations (Saraswathyamma *et al.*, 2006).

Results from the present study indicate a clear distinction between the clones with respect to a set of morphological traits. Shape of the leaf lamina appears to

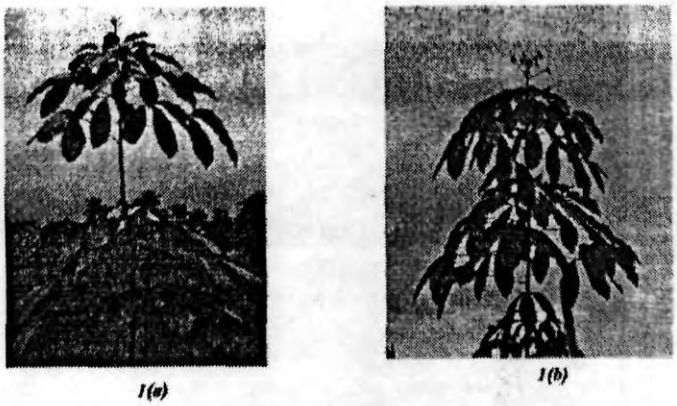

Fig. 1. Leaf storey. (a) well separated; (b) not well separated

Fig. 2. Leaf density. (a) open; (b) closed

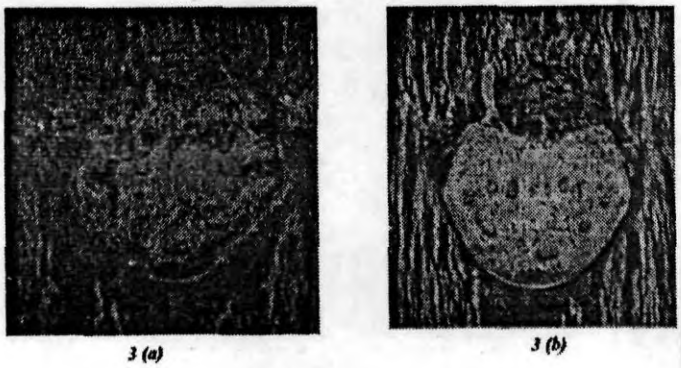

Fig. 3. Axillary bud. (a) normal; (b) protruded

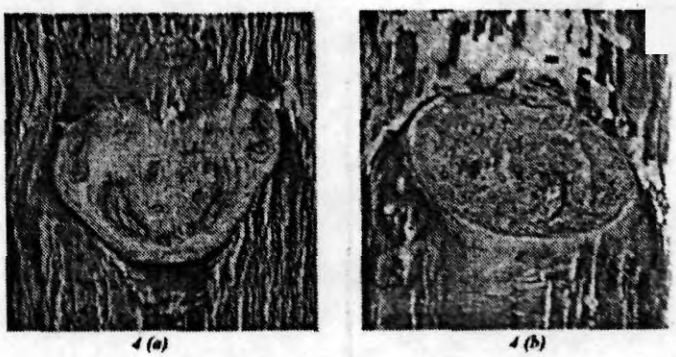

Fig. 4. Shape of leaf scar. (a) heart shaped; (b) circular

Fig. 5.Appearance of leaf scar. (a) normal; (b) protruded

Fig. 6. Petiolule (Angle of separation). (a) wide; (b) narrow

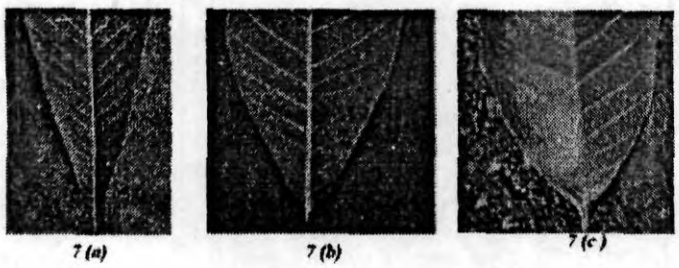

Fig. 8. Leaf base. (a) attenuate; (b) cuneate; (c) obtuse

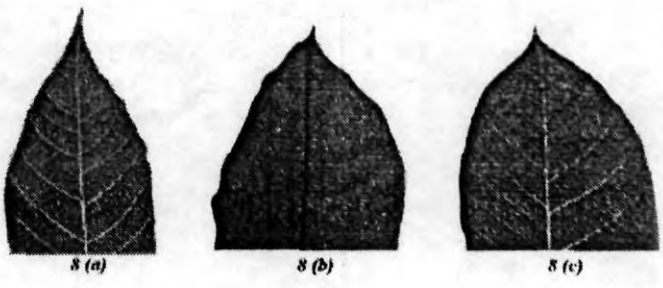

Fig. 8. Leaf apex. (a) acuminate; (b) apiculate; (c) cuspidate

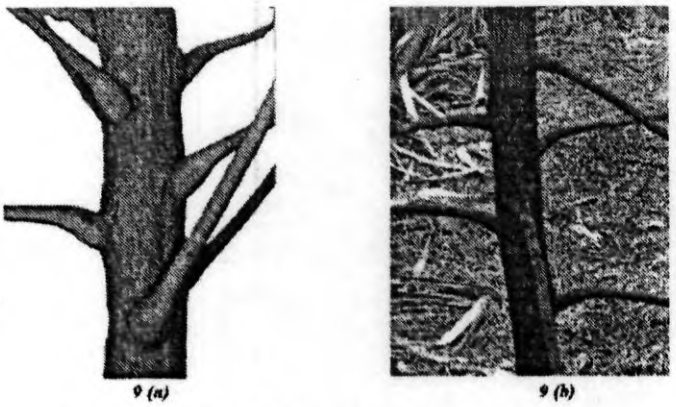

Fig. 9. Pulvinus. (a) bulged & spoon shaped; (b) normal

Fig. 11. Orientation of petiolule. (a) upward; (b) straight

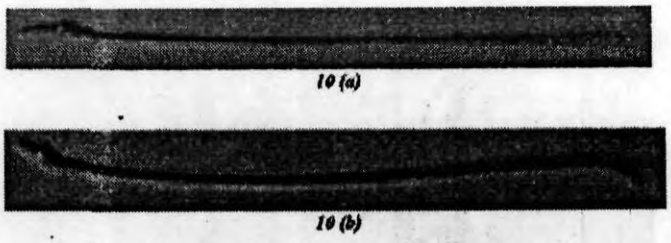

Fig. 10. Shape of petiole. (a) straight; (b) 'S' shaped

Fig. 12. Intramarginal venation. (a) prominent; (b) not prominent

Table 1. The unique diagnostic features of RRII 400 series clones

Character	RRII 414	RRII 417	RRII 422	RRII 429	RRII 430	RRII 105	RRIC 100
Leaf storey	Open, well separated, bow shaped	Open, well separated, bow to hemi-spherical shaped	Closed and dense, hemi-spherical, not well separated	closed, well separated, hemispherical to truncate	Partially closed to open, hemi-spherical, not well separated to diffuse	Open, well separated, bow shaped	Partially closed to open, well separated, hemi-spherical
Petiole	Long, slender, 'S' shaped; Orientation-downward	long, stout, straight; Orientation-horizontal	normal, straight; Orientation-downward	Normal, straight; Orientation-downwarda	Normal, straight to slightly concave; Orientation-horizontal	Long, straight; Orientation horizontal to upward	Normal; Orientation horizontal
Pulvinus	bulged and spoon shaped	Normal; broad	Normal	Normal	Normal	Normal	Normal
Petiolule	Long; Orientation-straight to upward; Angle of separation: wide	short and stout; Orientation horizontal; Angle of separation-normal	Short; narrow separation; Orientation-horizontal	short and straight; separation-narrow; Orientation-horizontal	Normal and steeply upward; separation - normal	Long; upward; separation - wide	Normal and upward; separation - narrow
Leaf lets	well	separated touching	separated to rarely touching to	Touching to separated	Overlapping to touching	Well separated	Touching to overlapping

Contd....

Character	RRII 414	RRII 417	RRII 422	RRII 429	RRII 430	RRII 105	RRIC 100
Lamina	long diamond elliptical; wavy margin	Obovate with irregularly wavy margin;	Long elliptical with irregularly wavy margin	Broad elliptical (short); smooth margin	Broad elliptical long; smooth margin	Diamond elliptical; margin smooth to slightly wavy	Broad elliptical; smooth margin
Texture	smooth	dull	Semi-glossy; rough slightly leathery	Non-glossy; leathery	Thick leathery; semi- glossy	Dark green glossy normal thickness	Thick leathery; semi glossy
Base	attenuate	Cuneate	Cuneate to obtuse	Cuneate to obtuse	Obtuse	Attenuate	Obtuse
Apex	acuminate	apiculate	Apiculate (formation of a diamond free space between the petiolule due to the overlapping of the adjacent leaflets); Number of leaves per storey high; leaf retention high)	Cuspidate (blunt tip)	Cuspidate (pointed tip)		Cuspidate (pointed tip)
Venation	Prominent, many and regular	Yellowish green, few and well separated (Asymmetry in lamina and venation are quite frequent)	Prominent, many and regular	Many and regular	Many and regular (Petiole-petiolule juncture raised; leaf shape resemblance to jack leaf)	Many and regular; intra-marginal veins not found	Regular
Additio nal informa-tion	Axillary bud protruded; drooping tendency of leaflets	Lamina, size of leaflet and venation are quite frequently asymmetrical	Formation of a diamond shaped free space between the petiolules due to overlapping of adjacent leaflets; leaves per storey high; leaf retention high	Drooping tendency of leaflets	Leaf scar protruded; petiole-petiolule juncture raised; leaf shape resemble that of jack leaf	Intramarginal veins not prominent	Broad, thick and glossy leaves

be the most reliable single character. With respect to leaf characteristics, RRII 414 shows a close affinity to the female parent RRII 105 and RRII 429 and RRII 430 show more resemblance to the male parent RRIC 100. The other two clones *viz.*, RRII 417 and RRII 422 are intermediate.

Morphological distinction for some of the traits are relatively narrow or overlapping which can confound the identification. Moreover, quantitative traits like petiole length, size of leaves and height of the plants as well as certain other characters like colour and orientation are in general highly influenced by the environment and hence does not allow a clear separation among the clones. Therefore, one should be cautious that a combination of as many traits as possible should be considered before drawing conclusive inferences.

Morphological studies on these clones will be further extended to mature trees for incorporating additional information on trunk characteristics, branching pattern, fruits, seeds etc. It has been reported that mature seeds of a single mother tree or clone exhibit the same colour, shape and mottlings which can be used to identify the clone with reasonable accuracy (Thomas *et al.*, 1996; Rao *et al.*, 2005; Saraswathyamma *et al.*, 2006). It is proposed to pass on the information generated from the present study to farmers through the extension officers of Rubber Board.

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