

# MULTI LOCATIONAL PERFORMANCE OF RRII 400 SERIES CLONES



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The planting recommendations of the Rubber Board for the traditional rubber growing regions of India include a total of 46 clones of which six, viz., RRII 105, RRII 414, RRII 417, RRII 422, RRII 430 and PB 260 are under Category 1 and intended for wide scale planting individually to the extent of 50% of the total area planted. Ten clones are included under Category 2 and these, in groups of 2-3 are recommended for planting in upto 50% of the area. The rest of the clones along with polyclonal seedlings are grouped under Category 3 and are intended for planting on a limited scale only.

Planting recommendations for the non traditional region of Northeast India include 19 clones and polyclonal seedlings. Of these, RRIM 600 is the only clone under Category 1, while nine promising clones are listed under Category 2 and nine under Category 3, including polyclonal seedlings.

Clones of the RRII 400 series were evolved by hybridization between the most popular high yielding clone of India, RRII 105, as the female parent and the Sri Lankan clone RRIC 100 as the male parent. These two parents being of proven genetic divergence, high levels of heterosis have been realized in the hybrid progeny. The RRII 400 series clones possess a combination of both growth vigour resulting in early tappable and high yield. Two of these clones, RRII 414 and RRII 430 were released for large scale cultivation in 2005. Two more of this series, viz., RRII 417 and

RRII 422 were released in 2009. A revision in the clone recommendations for the Northeast was also effected in 2009 with the upgradation of four clones of the RRII 400 series viz., RRII 429, RRII 422, RRII 417 and RRII 430 from Category 3 to Category 2.

The performance of the RRII 400 series clones in various field evaluations being conducted by the Rubber Research Institute of India (RRII) in the traditional and



Table 1: Yield of clones in the first large scale evaluation over 10 years of tapping

Large Scale Trial 1					
Clone	Yield - ** Panel BO-1 6yrs (g/t/t)	Summer yield Panel BO-1 (g/t/t) **	Yield PI.BO-2** 4yrs (g/t/t)	Yield 10 yrs. ** (g/t/t)	Yield per unit girth** (g/cm)
RRII 414	63.15 a	37.36 a	70.35 b	66.03 b	0.86 bcd
RRII 417	63.19 a	32.37 abc	89.33 a	73.65 a	0.96 a
RRII 429	58.90 ab	33.87 ab	64.66 b	61.20 bc	0.89 abc
RRII 105	50.45 cd	30.11 bc	73.05 b	59.49 cd	0.82 cd
Large Scale Trial 2					
RRII 422	67.47 a	41.75 a	73.60 b	69.92 a	0.98 a
RRII 430	67.24 ab	32.23 b	85.89 a	74.70 a	1.03 a
RRII 105	54.86 c	29.01 bc	73.05 b	59.49 bc	0.85 b

\*\* Significant variation at  $P < 0.01$

Values followed by the same letters are on par as per DMRT

non traditional regions of India is reviewed here along with initial results of post release follow up observations in small holdings across Kerala.

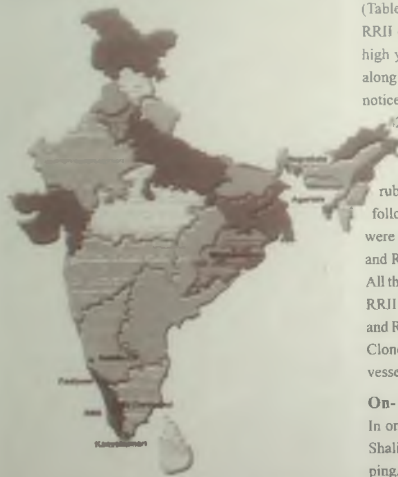


Fig. 2. Locations of ongoing field evaluations of RRII 400 series clones

### Large Scale Evaluation

Data from the first large scale trial at Central experiment Station (CES), Chethackal over 10 years of tapping (Table 1) on analysis proved the superiority of clones RRII 430, RRII 417, RRII 422 and RRII 414 over the high yielding check clone RRII 105. Clone RRII 105 along with clones RRII 430 and RRII 417 exhibited a noticeable increase in yield in panel BO-2. Clones RRII 422, RRII 414, RRII 417 and RRII 429 maintained high yields compared to RRII 105 in the summer months. Yield potential worked out in terms of rubber yield per unit girth was highest in RRII 430 followed by RRII 422, RRII 417 and RRII 429 which were superior to RRII 105. Clones RRII 430, RRII 417 and RRII 414 exhibited high timber yield potential too. All the five RRII 400 series clones were comparable with RRII 105 in the thickness of virgin bark, with RRII 429 and RRII 422 having a high number of latex vessel rows. Clone RRII 422 maintained the highest number of latex vessel rows in the renewed bark too.

### On- farm evaluations

In on-farm evaluations at Cheruvally, Vaikundam and Shaliacary estates over six, four and three years of tapping, clone RRII 105 recorded a yield of 1538, 1831 and 1669 kg/ha/year respectively, while the RRII 400 series clones in general, recorded higher yields (Table 2).

Table 2. Performance of RR11 400 series clones in large estates

Clone	Yield (kg/ha/yr)		
	Cheruvally Estate	Vaikundam Estate	Shaliacary Estate
RR11 414	1674	1976	1746
RR11 417	1657	2084	1795
RR11 422	1535	2194	1438
RR11 429	1674	2150	2380
RR11 430	1831	2128	—
RR11 105	2558	1831	1669

Fig.1. AAMI 2 biplot for genotype and environment

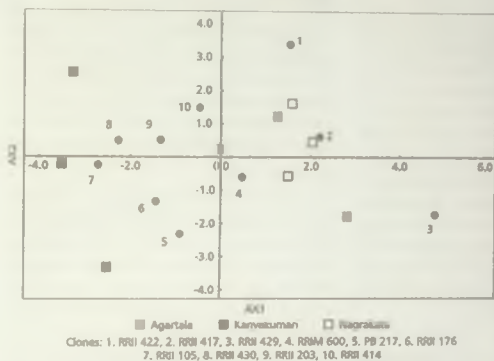


Table 3. Rubber yield over seven years in Kanyakumari, Nagrakata and Agartala

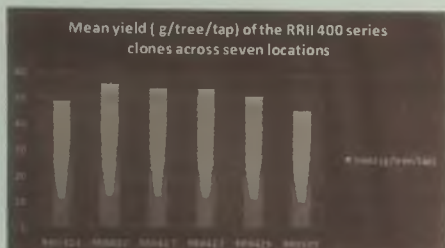
Clone	Mean yield (g/t/t)**		
	Kanyakumari	Nagrakata	Agartala
RR11 414	45.59 bcd	30.85 d	33.47 de
RR11 417	49.57 bc	46.84 b	40.12 bc
RR11 422	49.80 bc	47.52 b	47.05 a
RR11 429	38.93 d	56.18 a	44.37 ab
RR11 430	52.68 ab	40.78 bc	37.69 cd
RR11 105	57.46 a	38.23 c	37.85 cd
RR11 600	43.20 cd	35.99 cd	36.31 cd
RR11 203	58.39 a	—	—

\*\* Significant at  $P < 0.01$ , Values followed by same letters are on par as per DMRT

### Investigations in traditional and non-traditional regions

Analysis of the extent of interaction of the RR11 400 series clones with various environments ( $G \times E$  interaction) across the country (Fig.1) was done based on yield upto the sixth year of tapping. This study was based on multi environment trials planted in Kanyakumari, Agartala and Nagrakata. Clone RR11 105 along with RR11 430 and RR11 414 were found best suited to the Kanyakumari region and RR11 429, RR11 417 and RR11 422 were found suited to the Northeast. RR11 430 was found to be the most stable among the high yielding clones. RR11 429 was the highest yielding clone in the Northeast, but exhibited high interaction indicating low stability of performance across locations. There are indications from field trials in the immaturity stage in the Northeast that in the severely cold winters experienced in recent years, RR11 422 shows signs of cold injury which makes its initial establishment difficult.

An analysis of yield over seven years of tapping (Table 3) in Kanyakumari showed RR11 105 and RR11 430 to be at par and these were the highest yielders along with RR11 203, followed by RR11



**Fig. 3. Performance of the RR11 400 series clones in seven locations across the traditional and non-traditional rubber growing regions.**

422, RR11 417 and RR11 414. At Nagrakata, over seven years of tapping, RR11 429 was the highest yielder, followed by RR11 422, RR11 417 and RR11 414 which were also superior to RR11 105 and RR11 600. At Agartala, RR11 422 and RR11 429 were the highest yielders followed by RR11 417 and were superior to RR11 600 and RR11 105.

The yield of the RR11 400 series clones averaged across seven locations in the traditional and non-traditional regions in comparison to that of clone RR11 105 are given in Fig. 3. All the five clones exhibited better performance than RR11 105. Clone RR11 430 is the most stable and high yielding clone followed by RR11 422, RR11 417, RR11 429 and RR11 414.

### Drought tolerance

In areas that experience severely hot summers and prone

to moisture stress like Odisha (Bhubaneswar), Malabar (Padiyur) and Karnataka (Nettana), the drought tolerance of some of these clones was evident. Clones RR11 430 and RR11 417 performed best with yield superior to RR11 105 and RR11 600 in Padiyoor and Bhubaneswar. In Nettana, Karnataka, RR11 414 and RR11 430 were superior in yield to RR11 105 (Table 4).

The drought tolerance exhibited by RR11 430 is supported by results from physiological investigations at RR11 on intrinsic drought tolerance parameters. This

clone was found to maintain better water potential under drought, with better photosystem II activity, stable photosynthetic  $\text{CO}_2$  assimilation rate and a lower rate of photo oxidation of chlorophyll. Early growth and establishment of this clone in the drought prone North Konkan region of Maharashtra is also very promising.

### Secondary traits

Clones RR11 414, RR11 430, RR11 429 and RR11 422 have proven tolerance to abnormal leaf fall and corynespora leaf diseases. However, RR11 429 was found prone to pink disease and tapping panel dryness in large scale trials conducted in Kerala and Tripura. Clone RR11 430 exhibited low incidence of pink disease and good wind fastness. RR11 417 and RR11 422 also recorded no incidence of wind damage. Timber out put of all the RR11 400 series clones is superior to RR11 105. Wood quality

parameters like density and strength properties in the case of clones RR11 430 and RR11 417 were found to be among the best.

### Post release follow up in small holdings

As part of post-release follow up observations on the RR11 400 series clones in small holdings across Kerala, work was initiated in 16 small

**Table 4. Performance of RR11 400 series in Malabar, Orissa and Karnataka**

Clone	Padiyoor Mean yield over 4 years (g/t/t)	Bhubaneswar Mean yield over 2 years (g/t/t)	Nettana Mean yield over 3 years (g/t/t)
RR11 414	49.74	40.05	71.8
RR11 417	54.01	50.56	
RR11 422	49.64	46.28	59.7
RR11 429	44.30	49.31	57.8
RR11 430	58.27	52.76	65.6
RR11 105	49.75	25.23	41.3
RR11 600	38.16	48.59	

Table 5. Small holdings for post release follow up on RRII 400 series clones

Location	Planting year	Clones planted
<b>North Kerala</b>		
1. Erumapetty (Thrissur)	2002	RRII 403, RRII 414, RRII 422, RRII 105
2. Wandoor (Malappuram)	2000	RRII 414, RRII 422, RRII 105
3. Ottappalam (Palakkad)	2003	RRII 417, RRII 105
4. Mannarkadu (Palakkad)	2003	RRII 414, RRII 429, RRII 105
<b>Central Kerala</b>		
1. Malayattoor (Ernakulam)	2000	RRII 414, RRII 417, RRII 422, RRII 429, RRII 430, RRII 105
2. Thiruvankulam (Ernakulam)	2004	RRII 414, RRII 105
3. Pinnakanadu (Kottayam)	2006	RRII 422, RRII 105
4. Aiyankombu (Kottayam)	1998	RRII 429, RRII 105
5. Oonnukal (Ernakulam)	2003	RRII 414, RRII 422, RRII 429, RRII 430
6. Chirakadavu (Kottayam)	2005	RRII 414, RRII 417, RRII 422, RRII 429, RRII 430, RRII 105
7. Kanjirapally (Kottayam)	2005	RRII 414, RRII 417, RRII 422, RRII 429, RRII 430, RRII 105
8. Chettuthodu (Kottayam)	2002	RRII 414, RRII 105
9. Elanjil (Ernakulam)	2002	RRII 414, RRII 105
10. Ponkunnam (Kottayam)	2003	RRII 414, RRII 430
<b>South Kerala</b>		
1. Pathanapuram (Kollam)	2007	RRII 414, RRII 417, RRII 422, RRII 429, RRII 430, RRII 105
2. Ayoor (Kollam)	2001	RRII 414, RRII 417, RRII 422, RRII 429, RRII 430, RRII 105

Table 6. Early yield from small holdings with RRII 400 series clones

<b>Central Kerala</b>				
Location	Clone	No. of trees	DRC (%)	Yield (g/t/t)
*Ponkunnam	RRII 414	180	34	96
	RRII 105	25	31.5	38
Chettuthodu	RRII 414	275	35	88
	RRII 105	25	37	102
Pinnakkanadu	RRII 422	60	29	39
	RRII 105	25	26	40
Chemmalamattom	RRII 422	170	35	76
	RRII 105	25	40	57

Central Kerala				
Location	Clone	No. of trees	DRC (%)	Yield (g/t/t)
Ainkombu	RRII 429	74	32	56
	RRII 105	24	36	51
Elanji	RRII 414	246	34	69
	RRII 105	25	38	56
Malayattoor	RRII 414	41	38	24
	RRII 417	30	32	43
	RRII 422	14	29	46
	RRII 429	24	36	80
	RRII 430	49	35	43
	RRII 105	53	39	44
Oonnukal	RRII 414	335	28	43
	RRII 422	230	33	49
	RRII 429	300	22	24
	RRII 430	325	27	53
North Kerala				
Ottappalam	RRII 417	262	26.2	50.74
	RRII 105	247	29.8	40.05
Wandoor	RRII 414	40	36.75	68.90
	RRII 422	40	28.75	41.68
	RRII 105	40	32.75	65.5
South Kerala				
Ayur (Kollam)	RRII 414	70	32.7	68.0
	RRII 417	50	33.1	67.1
	RRII 422	55	33.9	81.0
	RRII 429	115	33.1	68.8
	RRII 430	16	35.0	55.9
	RRII 105	50	36.5	41.2

\* Tapping initiated in all the trees of RRII 414 in the 5th year after planting. RRII 105 attained tappable girth in the 7th year of planting.

holdings in which these clones were planted along with RRII 105. Table 5 lists the holdings under study in south, central and north Kerala. Of these, tapping has been initiated in 11 holdings (Table 6).

The initial results indicate clones RRII 430 and RRII 417 to be better than RRII 105 in all the three holdings under tapping, RRII 414 to be better than RRII 105 in 4 out of seven holdings, RRII 429 to be better than RRII 105 in three out of four holdings and RRII 422 to be better in 3 and comparable in two out of six holdings.

## Conclusion

Long term results from the statistically laid out trials being conducted by the RRII in various locations (Figure 2) justify the release of the clones RRII 430, RRII 414, RRII 417 and RRII 422. Post release observations from small holdings also corroborate the research findings, though regional variations in clonal performances in terms of rubber yield are evident. This can be attributed to G x E interactions. However, clone RRII 430 is found to be stable across locations.