Genetic improvement of cocoa by developing superior hybrids

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Received 5 November 2015; received in revised form 21December 2015; accepted 29 December 2015

Abstract

Cocoa (*Theobroma cacao* L.) is the only source of chocolate. Artificial synthesis of chocolate is presently impossible due its complex chemical composition. In India commercial cultivation of cocoa started during 1970 and the country is considered as a potential source for cocoa by many chocolate companies. Cocoa exhibits heterosis in yield and yield contributing characters and development of hybrids have played a key role in uplifting cocoa cultivation in many countries. Kerala Agricultural University (KAU) had a vital role in developing cocoa cultivation in India with superior planting materials and improved agro techniques. Thousands of hybrids evolved as the part of hybridization programmes were field established and evaluated for more than twelve years for their consistent performance. The present study envisaged the evaluation of forty hybrids developed through various breeding programmes. As a result of this study five hybrids were identified as superior with high yield and other desirable pod and bean characters. They also exceeded in performance over the check variety CCRP 8, most popular hybrid among farmers which was released earlier by Cocoa Research Centre of KAU. Hence these hybrids viz. CCRP 11 (SIV 1.26), CCRP 12 (SIV 2.29), CCRP 13 (SIV 4.29), CCRP 14 (SIV 6.18) and CCRP 15 (VSD I 31.8) were released by the Government for commercial cultivation during 2015.

Key words: Cocoa, Heterosis, Hybrids, *Theobroma cacao,* Vascular streak die back

Introduction

Cocoa (*Theobroma cacao* L.), "chocolate tree" is the only source of chocolate. History of cocoa begins in tropical humid forest on the lower eastern equatorial slopes of Andes in South America (Wood and Lass, 1985). Cocoa was introduced to India during 1798 (Ratnam, 1961), but its commercial cultivation started only during 1970's (Prasannakumari et al., 2009). Now the crop is widely cultivated throughout the south Indian states. Many multinational companies consider India as a potential source for cocoa and started establishing their factories in the country.

Physiological and genetic investigations had unveiled that the yield potential of cocoa is not yet fully exploited (Bertus, 2004). Average cocoa productivity in India is estimated as 2.5 kg/tree/year dry bean (DCCD, 2015). Demand for chocolate is increasing at a rate of 15-20 percent every year. And to meet this demand more area has to be brought under cocoa cultivation using improved genetic stock. Development of superior hybrids had significantly contributed to lift cocoa productivity in many countries (Kennedy et al., 1987; Dias et al., 2003).When cocoa hybrids were evaluated for their performance it was observed that they showed wide adaptability, low environmental interaction , improved yield when compared to traditional local cultivars (Dias et al., 2003). As discussed by Dias (2011) the history of cocoa can be divided into two, before and after the development of hybrids. Cocoa (*Theobroma cacao* L.) exhibits strong heterosis for yield and yield contributing characters (Atanda and Toxopeus, 1971; Dias and Kageyama, 1997).

With an objective to exploit the heterosis in cocoa, breeding programme was initiated in KAU during 1979. The major drawback in cocoa hybrid

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production is in the selection of parents. Crosses are conducted randomly without information about the performance of the parents which will result in production of poor progenies (Dias and Kageyama, 1995). The efficiency of cocoa breeding programme can be increased by choosing the superior clones (Dias and Kageyama, 1997). The exotic and indigenous germplasm collections maintained at the station are evaluated for their yield, yield contributing characters, resistance to various diseases etc. Based on the *per se* performance parents for different breeding programmes are selected and hybridization is done by controlled pollination. The result of these programmes yielded thousands of hybrids and they were field established under various trials. These hybrids are further evaluated for selecting superior ones. This paper explains a part of research work conducted by KAU for improving the genetic makeup of cocoa and thus uplifting status of cocoa cultivation in India.

Materials and methods

The experiment comprises of hybrids selected from different trials viz. Progeny trial I (32 number), Series III (3 number), Series IV (10 number) and Vascular Streak Dieback I (5 number). Trials Progeny I (P I), Series III (S III) and Series IV (S IV) were conducted to evolve high yielding hybrids. From all these trails after through screening 1135 hybrids were field established (Minimol et al., 2011). Vascular Streak Dieback I (VSD I) trial is to evolve high yielding hybrids resistant to vascular streak die back disease, which is caused by the fungi *Oncobasidium theobromae* (Talbot and Keane, 1971), now renamed as *Ceratobasidium theobromae* (Samuels et al. 2012) . The striking fact is that there is no effective chemical control recommended for this disease and only viable solution is to produce resistant planting materials (Prior, 1980; Ajaykumar, 1996). In VSD resistant trial after screening for two years in the net house under artificial condition 1177 hybrids exhibited disease resistance and early vigour were field established (Suma and Minimol, 2015) and superior ones were identified after field screening (Minimol et al., 2014).

Forty hybrids identified to be superior after

Table 1. Details of hybrids selected for comparative yield trial

Hybrid	Parentage
PI 8.12	V5/9X 61
PI 19.11	V 9/6X 51
VSDI 26.15	G VI 176 X G IV 18.5
VSDI 22.11	G VI 170 X G VI 55
PI 4.19	V 4/8 X 54
SIV 1.12	GI 5.9 X GI 10.8
VSDI 26.7	G VI 182 X G VI 4
PI 7.9	V 10/3 X64
PI 2.16	V 15/5 X54
SIV 2.29	GI 5.9 X S 27.16
PI 12.11	V 5/9 X 64
SIV 5.30	GVI 54 X GI 5.9
PI 16.12	V 10/3X 54
PI 8.10	V 9/6 X 68
PI 18.22	V15/5 X59
PI 3.19	19/5 X 16/9
SIII 1.7	9/16 X GI 53
SIV 2.16	GII 19.5 X GI 5.9
SIV 3.9	GVI 64 X GI 5.9
VSDI 30.16	G VI 188 XG VI 55
PI 7.21	V 10/3 X 68
VSDI 31.8	G VI 189 X G VI 55
PI 5.20	V 15/5 X 55
SIV 1.26	GI 15.5 X GI 5.9
PI 6.8	59X 16/9
PI 10.23	V 15/5 X 56
SIV 4.29	GI 5.9 X S 27.16
PI 4.14	V 9/6 X 61
PI 2.21	16/9 X56
PI 19.23	V 10/3 X 61
PI 2.10	V 9/6 X 55
PI 14.23	V 4/8 X 16/9
PI 11.14	V 5/9 X 64
SIII 4.3	V 4/8 X 52
SIV 5.5	GVI 50 X GI 5.9
PI 13.1	V5/9 X 61
SIV 3.3	M 13.12 X G I 5.9
SIV 6.18	GI 5.9 X GIII 4.1
PI 13.18	V10/3 X 56
SIII 3.3	V 4/8 X 64

Table 2. Yield data of hybrids for ten years after reaching steady bearing (No. of pods/tree/year)

Hybrid No.	Genotype	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Pooled mean
P1	PI 8.12	48.33	50.33	48.67	47.33	50.17	54.67	58.17	62.00	64.00	54.67	56.767^{HIJK}
P2	PI 19.11	21.00	16.67	19.17	17.17	24.33	23.33	27.83	27.67	29.67	28.8	25.867
P3	VSDI 26.15	60.75	64.00	51.75	50.75	54.00	58.75	70.00	70.50	76.25	79.75	65.267^{GH}
P4	VSDI 22.11	31.67	40.00	49.17	31.67	32.25	31.83	30.67	35.00	34.67	32.83	38.6^{NOPQR}
P5	PI 4.19	25.00	20.67	20.17	22.67	24.17	23.00	25.67	23.83	26.33	26.50	25.5
P6	SIV 1.12	35.67	32.00	36.33	39.00	35.67	35.00	29.33	32.33	36.00	32.00	34.333
P8	VSDI 26.7	67.17	65.5	59.67	64.50	60.50	58.67	63.83	58.50	59.67	59.83	63.933^{GH}
P9	PI 7.9	53.33	59.67	60.00	62.33	62.00	59.33	63.00	61.66	67.00	63.33	61.167^{GHI}
P10	PI2.16	51.20	51.00	56.00	48.00	55.60	55.20	57.40	59.40	65.60	68.00	58.133^{HIJK}
P11	SIV 2.29	120.40	128.00	134.00	139.0	143.60	142.00	142.00	141.00	143.80	140.80	136.967^{A}
P12	PI 12.11	28.17	30.17	30.33	34.33	32.33	32.33	35.83	36.17	37.83	40.00	36.533
P13	SIV 5.30	24.60	23.40	35.20	30.60	26.60	28.80	31.20	30.80	29.60	29.60	28.467
P14	PI 16.12	19.50	23.00	17.83	21.00	21.67	26.67	29.17	32.67	34.83	29.67	27.067
P15	PI 8.10	47.33	43.17	47.83	47.50	46.67	44.33	39.33	55.67	58.50	60.17	52.567^{IJKLM}
P16	PI 18.22	22.00	24.00	19.25	18.00	21.25	24.50	28.25	26.75	24.75	25.50	24.333
P17	PI 3.19	36.50	38.33	40.33	40.17	42.00	43.83	46.33	46.67	45.83	38.33	44.767^{LMNOP}
P18	SIII 1.7	18.50	21.50	18.83	21.33	19.50	19.83	24.17	22.33	25.67	27.33	23.567
P19	SIV 2.16	32.17	27.00	22.17	27.33	25.50	27.33	34.17	32.00	31.50	32.50	30.6
P20	SIV 3.9	17.20	13.83	17.83	16.33	20.67	25.33	23.67	28.67	31.17	33.83	24.333
P21	VSDI 30.16	59.67	58.50	57.67	51.67	66.50	67.67	76.67	78.50	77.67	77.33	70.2^{FG}
P23	PI 7.21	25.67	28.17	26.33	29.83	26.33	25.33	30.17	31.17	29.50	31.50	29.533
P24	VSDI 31.8	80.00	80.00	84.00	88.00	86.00	90.00	88.00	89.00	90.00	88.00	88.133^{D}
P25	PI 5.20	31.33	29.83	33.33	29.00	34.50	34.33	36.17	35.33	38.17	37.67	36.4
P26	SIV 1.26	60.50	125.83	127.83	136.0	123.50	138.00	136.00	137.00	136.00	133.17	128.8^{AB}
P27	PI 6.8	50.67	52.50	50.00	51.17	46.67	40.83	43.67	43.17	41.67	42.67	48.833^{JKLMN}
P29	PI 10.23	31.00	36.83	33.17	37.83	32.00	31.17	29.67	33.00	33.67	36.83	34.9
P30	SIV 4.29	83.40	97.00	99.00	100.0	99.00	98.00	101.00	102.00	102.00	99.00	99.467^{C}
P31	PI 4.14	53.33	42.33	41.67	47.67	37.00	35.00	43.33	46.33	48.67	48.00	44.333^{MNOP}
P33	PI 2.21	53.67	56.67	59.00	42.83	61.83	61.17	62.17	60.33	61.83	61.17	59.3^{GHIJ}
P34	PI 19.23	50.00	85.00	82.00	91.00	95.00	96.00	96.00	94.00	95.00	94.00	89.467^{CD}
P35	PI 2.10	75.00	78.00	77.83	82.00	84.00	83.00	82.00	81.00	83.00	82.00	44.967^{LMNOP}
P36	PI 14.23	75.00	78.00	77.83	82.00	84.00	83.00	82.00	81.00	83.00	82.00	82.367^{DE}
P37	PI 11.14	40.00	36.50	31.50	33.50	36.25	41.75	42.50	40.25	35.25	41.25	39.633^{NOPQ}
P38	SIII 4.3	49.17	35.33	39.00	39.17	43.50	53.33	54.17	48.83	47.83	51.83	48^{KLMN}
P39	SIV 5.5	28.83	26.00	25.17	20.83	26.50	28.33	33.17	33.17	32.33	33.50	29.5
P40	PI 13.1	19.83	22.50	22.00	19.00	25.83	26.83	46.33	33.17	35.50	45.33	36.633^{OPQRS}
P41	SIV 3.3	49.33	45.67	51.00	40.17	53.17	55.33	59.33	63.83	64.17	67.33	55.867^{HIJKL}
P42	SIV 6.18	121.40	112.00	123.00	95.60	118.00	125.00	123.00	120.00	121.00	123.00	121.7^{B}
P44	PI 13.18	14.67	15.50	14.83	15.17	20.50	24.83	23.83	31.67	35.50	37.33	24.833
P45	SIII 3.3	71.67	75.00	70.00	76.67	77.33	80.00	77.33	80.83	77.67	78.83	76.567^{EF}
CV (%)	36.99	11.59	19.69	9.98	13.57	11.46	9.30	33.26	9.00	11.22	12.724	
CD (0.05)	19.24	6.39	11.00	5.55	7.81	6.79	5.78	20.85	5.74	7.19	11.109	

Super script indicates the rank order in ascending manner preliminary screening from various trials were planted as budded plants in a comparative yield trial during 1998 (CCRP report 1999) (Table 1). The design used was RBD with six replications. Yield data were recorded as number of pods per tree per year from 2004 onwards and pooled mean analysis was carried out to evaluate the performance of these hybrids. Twelve hybrids that performed best in the trial were further short listed for pod and bean analysis. From these observations economic characters like pod index ie. number of pods required to produce one kilogram dry cocoa beans (Morera et al., 1991), wet bean weight per tree per year (kg) (average wet bean weight of a single pod (kg) × number of pods per tree per year) and dry bean weight per tree per year (kg) (average single dry bean weight (kg) × number of beans per pod × number of pods per tree) were computed. Heterobeltiosis was estimated using the formula described by Russell et al. (1952)

Heterobeltiosis (%) =

$$\frac{\text{F1-Performance of better parent}}{\text{Performance of better parent}} \times 100$$

To test the significance of difference of F_1 mean over better parent, critical difference (CD) was worked out. CD was calculated from the standard error of difference as given below (Briggle, 1963).

$$CD(0.05)/(0.01) = te'(0.05)/(0.01) \times \sqrt{2MSE/r}$$
$$= te'(0.05)/(0.01) \times SE$$

Where, te' - critical value of t statistic at 5 % level of significance or at 1% level

MSE - Error mean square

r - Number of replications

SE - Standard error of difference between two means

To know the improvement of hybrids over the check, percentage was computed using the formula.

Percent increase over check =

$$\frac{\textit{Performance of hybrid - performance of check}}{\textit{Performance of check}} \times 100$$

CCRP 8 (released hybrid of KAU) most popular among farmers was used as the check. WASP

Table 3. Rank order of hybrids after pooled mean analysis for number of pods /tree/year

Hybrid No.	Genotype	Yield arranged according to rank order
P11	SIV 2.29	136.967
P26	SIV 1.26	128.800
P42	SIV 6.18	121.700
P30	SIV 4.29	99.467
P34	PI 19.23	89.467
P24	VSDI 31.8	88.133
P36	PI 14.23	82.367
P45	SIII 3.3	76.567
P21	VSDI 30.16	70.200
P3	VSDI 26.15	65.267
P8	VSDI 26.7	63.933
P9	PI 7.9	61.167
P33	PI 2.21	59.300
P10	PI2.16	58.133
P1	PI 8.12	56.767
P41	SIV 3.3	55.867
P15	PI 8.10	52.567
P27	PI 6.8	48.833
P38	SIII 4.3	48.000
P35	PI 2.10	44.967
P17	PI 3.19	44.767
P31	PI 4.14	44.333
P37	PI 11.14	39.633
P4	VSDI 22.11	38.600
P40	PI 13.1	36.633
P12	PI 12.11	36.533
P25	PI 5.20	36.400
P29	PI 10.23	34.900
P6	SIV 1.12	34.333
P19	SIV 2.16	30.600
P23	PI 7.21	29.533
P39	SIV 5.5	29.500
P13	SIV 5.30	28.467
P14	PI 16.12	27.067
P2	PI 19.11	25.867
P5	PI 4.19	25.500
P44	PI 13.18	24.833
P16	PI 18.22	24.333
P20	SIV 3.9	24.33
P18	SIII 1.7	23.567

Table 4. Pod and bean characters of top twelve high yielders

Hybrid no.	Genotype	Single Pod weight (g)	Wet bean wt/pod (g)	No. of beans /pod	Single dry bean weight (g)
P11	SIV 2.29	560.4^{D}	136.97^{E}	35.47^{EFG}	1.067^{C}
P26	SIV 1.26	639.5^{C}	160.3^{C}	36.93^{DE}	1.300^{AB}
P42	SIV 6.18	547.0^{D}	169.4^{B}	40.77^{C}	1.233^{B}
P30	SIV 4.29	716.9^{B}	154.5^{D}	35.60^{DEFG}	1.367^{AB}
P34	PI 19.23	241.1^{J}	64.33^{L}	28.50^{I}	0.7667^{EF}
P24	VSD 31.8	870.2^{A}	200.1^{A}	48.40^{A}	1.433^{A}
P36	PI 14.23	282.5^{I}	82.83^{J}	33.40^{GH}	0.800^{EF}
P45	SIII 3.3	312.8^{H}	78.33^{K}	36.23^{DEF}	0.7667^{EF}
P21	VSD 30.16	429.6^{E}	117.3^{F}	34.47^{FG}	1.000^{CD}
P3	VSD 26.15	397.3^{F}	112.7^{G}	31.90^{H}	1.000^{CD}
P8	VSD 26.7	342.5^{G}	96.23^{H}	37.73^{D}	0.8667^{DE}
P9	VSD 26.7	339.39^{GH}	89.67^{I}	45.73^{B}	0.7000^{F}
CV (%)	2.94	1.78	3.56	8.13	
CD (0.05)	23.31	3.63	2.23	0.145	

Super script indicates the rank order in ascending manner

(2015) was used for the statistical analysis.

Results and discussion

Cocoa is expected to attain stable yield after five years of planting (Mallika et al; 2000). Hence observations on yield were recorded from 2004 and data for ten years (2004 – 2013) are depicted in Table 2. Irrespective of hybrids, yield varied across the year (Lockwood, 1976). Even the hybrids of same cross manifested difference in yield and the result were in concurrence with earlier work by Daniel et al., (2014).

As described by Dias (2011) cocoa hybrids are non-conventional type with genetic structure of double hybrids with adequate variability providing ample scope for viable selection within the hybrids. Hence for selecting superior ones among the 40 hybrids studied, pooled mean analysis was carried out for number of pods per tree per year (yield). Based on the performance, hybrids are ranked and arranged in Table 3. Generally in cocoa breeding programme attention was given to maximize potential yield (Kennedy et al., 1987), hence twelve hybrids with highest number of pod per tree per year were selected for further pod and bean analysis.

The increase in potential yield can be achieved by maximizing yield contributing characters like pod and bean size, wet and dry bean weight etc. (Toxopeus and Jacob, 1970; Yapp and Phua, 1987). Hence single pod weight (g), wet bean weight per pod (g), number of beans per pod and single dry bean weight (g) were estimated and the data is portrayed in Table 4. VSD I 31.8 showed superiority in all characters studied i.e. pod weight (870.2 g), wet bean weight per pod (200.1 g), number of beans per pod (48.4 g) and single dry bean weight (1.433 g).

Pod weight (g) was considered as the first criteria for selection. Desirable pod weight of cocoa was delineated to be 350 g (Kumaran and Prasannakumari, 1982) and five hybrids recorded pod weight above this value (SIV 1.26, SIV 2.29, SIV 4.29, SIV 6.18 and VSD I 31.8). 130 g is the desirable wet bean weight (Prasannakumari et al., 2009) and all the above five hybrids exhibited a value more than this. Number of beans cannot be considered as an indicator for good trait because

Table 5. Economic characters of selected twelve hybrids

Hybrid no.	Genotype	Pod Index	Wet bean weight/ plant/year (kg)	Dry bean weight/ plant/ year (kg)
P11	SIV 2.29	24.81^{EF}	18.72^{B}	5.083^{B}
P26	SIV 1.26	20.93^{FG}	20.64^{A}	6.183^{A}
P42	SIV 6.18	20.17^{G}	20.63^{A}	6.140^{A}
P30	SIV 4.29	20.61^{FG}	15.36^{D}	4.840^{B}
P34	PI 19.23	46.28^{A}	5.757^{HI}	1.943^{C}
P24	VSD 31.8	14.43^{H}	17.63^{C}	6.110^{A}
P36	PI 14.23	37.44^{B}	6.823^{G}	2.200^{C}
P45	SIII 3.3	36.24^{B}	6.000^{H}	2.127^{C}
P21	VSD 30.16	29.02^{CDE}	8.230^{E}	2.420^{C}
P3	VSD 26.15	26.78^{DE}	7.360^{F}	2.573^{C}
P8	VSD 26.7	30.68^{CD}	6.153^{H}	2.093^{C}
P9	VSD 26.7	31.74^{C}	5.480^{I}	1.960^{C}
CV (%)	9.057	2.29	10.41	
CD (0.05 %)	4.313	0.436	0.640	

Super script indicates the rank order in ascending manner

large number of beans with small bean size is not recommended (Engles, 1982). This is because it results in low fat content (Enriquez and Soria, 1966 and Rubeena, 2015). To meet international cocoa standards (GoI, 1997), single dry bean weight must be more than one gram. All the five hybrids which displayed desirable pod weight and wet bean weight also expressed more than one gram single dry bean weight.

Economic characters of these hybrids were also estimated as by the formula described under materials and methods and the results are bestowed in Table 5. Low value for pod index is the desirable character and thus VSD I 31.8 expressed the most desirable value in terms of pod index. Average recommended wet bean weight per tree per year is 12 kg (Kissan Kerala, 2015) and selected five hybrids expressed wet bean weight above this value. Average dry bean weight ranged from 0.5 – 2.5 kg (Lachenaud et al., 2007) and more than 2.5 kg is deemed to be most desirable (Neela et al., 2014). The selected hybrids indicated high level of recovery percentage and maximum yield was with SIV 1.26 (6.45 kg).

Table 6. Heterobeltiosis (%) of the selected hybrids

Hybrids	Parentage		No. of pods/tree/year				Wet bean wt. /tree/year (kg)				Dry bean wt./tree/year (kg)			
	Female	Male	Genotype of better parent	Mean value of better parent	Mean value of hybrid	HB (%)	Genotype of better parent	Mean value of better parent	Mean value of hybrid	HB (%)	Genotype of better parent	Mean value of better parent	Mean value of hybrid	HB (%)
SIV 1.26	GI 15.5	GI 5.9	GI 5.9	68.5	128.8	83.04*	GI 5.9	6.49	20.64	230.5**	GI 15.5	2.3	6.18	180.43**
SIV 2.29	GI 5.9	S 27.16	S 27.16	31.25	136.97	339.9**	GI 5.9	6.49	18.72	194.7**	GI 5.9	1.93	5.08	176.01**
SIV 4.29	GI 5.9	S 27.16	S 27.16	31.25	99.47	213.73**	GI 5.9	6.49	15.36	121.00**	GI 5.9	1.93	4.84	147.7**
SIV 6.18	GI 5.9	G III 4.1	GI 5.9	29.76	121.70	297.2**	G III 4.1	8.09	20.63	63.7**	G III 4.1	2.84	6.14	55.4**
VSD 31.8	GVI 189	G VI 55	GVI 189	22.6	88.13	281.85**	G VI 55	10.15	17.63	69.5**	G VI 55	2.82	6.11	103.3**
	SE			3.187				0.710				0.353		
	CD (0.05)			6.563				1.463				0.727		
	CD (0.01)			8.88				1.980				0.984		

* Significant at 5% level
**Significant at 1% level

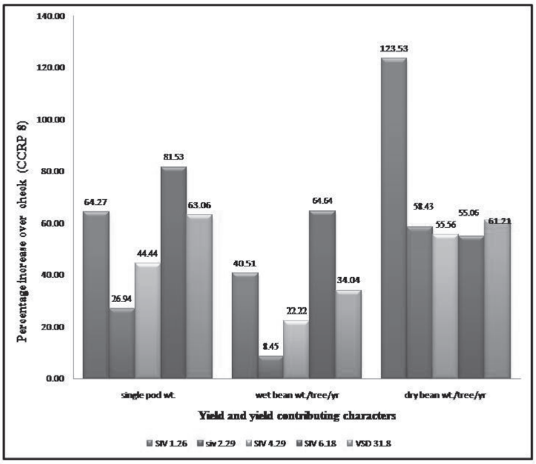

Figure 1. Percentage increase of yield contributing characters of hybrids over the check CCRP 8

Superiority of hybrids over better parents (heterobeltiosis) were estimated for no. of pods/ tree/year, wet bean weight/ tree/ year and dry bean weight / tree/ year and presented in table 6. All five hybrids showed significant superiority over their better parent in all characters studied. Five hybrids that satisfied all criteria of selection (SIV 1.26, SIV 2.29, SIV 4.29, SIV 6.18 and VSD I 31.8) were compared with the check CCRP 8. All the hybrids selected expressed a high percentage increase over the check (Fig. 1) stating that they can be used as new planting material in place of existing varieties. Hence it was approved by state variety release committee of Kerala, India (KAU News, 2015) and released as CCRP 11 (SIV 1.26), CCRP 12 (SIV 2.29), CCRP 13(SIV 4.29), CCRP 14(SIV 6.18) and CCRP 15(VSD I 31.8).

Considering the area brought under cultivation and seed material distributed from KAU directly and through Mondelez International, it can be concluded that 90 per cent of India's cocoa gardens are established with planting materials from KAU. The interesting fact is that area under cocoa cultivation is increasing at a rate of 10 per cent every year (DCCD 2015). Many International companies now consider India as the potential source for cocoa beans. The newly released hybrids, as budded plants or hybrid seedlings produced from polyclonal gardens established using these hybrids as parental materials, will definitely improve the status of India's cocoa production in the world map.

Acknowledgement

We acknowledge Mondelez International (earlier Cadbury India Ltd.) for their continuous association and financial support for 30 years.

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