International Journal of Research in Biosciences
Vol. 5 Issue 4, pp. (19-26), October 2016
Available online at http://www.ijrbs.in
ISSN 2319-2844

Research Paper

Selection strategy for identification of high yielding cashew hybrids

Kabita Sethi[1], [*]Swapan K. Tripathy[2], Devraj Lenka[3] and Prabhu C. Lenka[1]
[1]Department of Fruit Science and Horticulture Technology, College of Agriculture, OUAT, Bhubaneswar, INDIA
[2]Department of Agricultural Biotechnology, College of Agriculture, OUAT, Bhubaneswar, INDIA
[3]Department of Plant Breeding & Genetics, College of Agriculture, OUAT, Bhubaneswar, INDIA

(Received August 14, 2016, Accepted September 13, 2016)

Abstract

A set of sixty cashew hybrids were assessed for their genotypic worth as compared to their parents and three standard checks (BPP 8, BH 6 and BH 85). BPP 8 was found to be the best standard check variety for nut yield as it significantly out yielded BH 6 and BH 85. Estimates of Y-hat components revealed importance of the number of perfect flowers/m^2, canopy spread, number of flowering laterals/m^2 and plant height for expression of nut yield. Five top ranking hybrids e.g., D 19, H 6, B 27, A 71 and G 8 selected based on rank score of these component traits, were the top yielder among the hybrids. D 19 revealed significantly higher number of flowering laterals and nut weight while, H 8 had significantly more canopy spread (North-South direction), sex ratio and number of nuts/panicle. Superiority of B27 and A 71 was attributed to taller plant type with significantly more canopy spread (both East-West and North-South direction) and higher number of flowering laterals/m^2 and nuts/panicle. Such heterotic hybrids may be considered for large scale multiplication and follow-up commercial cultivation.

Keywords: Selection strategy, partial regression analysis, morpho-economic traits, cashew (*Anacardium occidentale* L.)

Introduction

Cashew (*Anacardium occidentale* L.) is an important evergreen tropical tree crop with enormous commercial importance. India is the largest producer (7.28 lakh tonnes) of cashew over an area of 9.82 lakh hectares with a productivity of 772kg/ha[1]. Other major producers are Tanzania, Mozambique and Kenya. Indian earns $910 million from export of cashew kernel during 2014-15. Maharashtra, Andhra Pradesh, Karnataka and Odisha are the major cashew growing states in India. Large variation in cashew genotypes do exist in the coastal region of India[2]. It generates random variation through open pollination and maintains high level of heterozygosity in the natural population owing to its clonal propagation. Many workers attempted to exploit such genetic variations and /or heterosis through development of cashew hybrids[3-7]. However, productivity of cashew in India continues to be low due to non-availability of elite clones[8]. Broadening the genetic base of existing germplasms by hybridization and systematic exploitation of heterosis could pave the way for overcoming the problem of low productivity[9]. Therefore, an ambitious cashew hybridization programme was taken up to develop and identify suitable heterotic hybrids with high nut yield potential. In this pursuit, the authors stressed upon suitable selection strategy for selection of high yielding cashew hybrids as compared to their parental genotypes.

Kalyanpur Bold Nut, Cross B - RP-1 x VTH -711/4, Cross C – RP-2 x Kankadi, Cross D – M-44/3 x VTH 711/4, Cross E – RP-1 x Kankadi, Cross F – RP-2 x VTH711/4, Cross G - RP-2 x Kalyanpur Bold Nut, Cross H - M-44/3 x Kalyanpur Bold Nut, Cross I - Vittol- 44/3 x VTH 711/4 and Cross J-

BPP-30/1 x Kalyanpur Bold Nut were developed in the year 2001 using eight parents (having desirable traits such as bold nut type, profuse flowering, cluster bearing, high shelling percentage (> 28%) and nut yield (> 2 ton/ha). These cashew hybrids are designated in terms of alphabetical letters followed by numerical numbers to refer cross combination and hybrid clone number. The nuts of different crosses were collected at full maturity and seedlings were raised in the nursery as per standard package of practices. After attaining desired growth, the seedlings were planted in the main field with a spacing of 7.5m x 7.5 m in the year 2002. The experimental materials included 71 cashew nut test genotypes[6] comprising above 60 experimental hybrids, eight parents and three standard checks (BPP 8, BH 6 and BH 85) laid out in an augmented design with three blocks (to accommodate 20 hybrids and all parents and checks in each block) for evaluation and selection of promising hybrid (s) over two years (2011 and 2012). Observations on vegetative, yield and yield attributing traits were recorded wherever applicable, as per the standard descriptor of cashew[10] and pooled over two years. Data were subjected to routine statistical analysis following Panse and Sukhatme[11]. The partial regression coefficients for yield determining traits were worked out to fit the regression equation as per method of Singh and Choudhury[12].

Results and Discussion

Variation and selection are the two basic requirements of genetic improvement in any crop. Without variation, selection becomes ineffective. Many often direct selection based on per se nut yield led to missing of valuable breeding materials which otherwise have potential genotypic worth for some specific traits. The genotypes which represent the favourable extreme boundary of the range variation may occur at very little frequency, but these would provide the necessary base for the desired direction of selection. Therefore, the knowledge of selection strategy is very crucial for efficient sampling and utilization of genetic resources. With a view to quest a reliable and practically feasible selection parameter, an attempt was made to optimize the selection strategy for identification of promising high yielding cashew hybrids. Yield is an artifact [13,14]. Direct selection based on *per se* mean performance often led to statistical error and lack of precision. Regression analysis of component traits on nut yield could establish a basis of selection based on important yield contributing characters. In the present set of test materials, the partial regression co-efficients for 13 nut yield determining traits were worked out (Table 1**)** with a view to fit the regression equation Y(Nut yield)= 4.976 + 0.266X_1 + 0.01X2 + 0.273X3 + 0.614X4 + 0.092X 5 + 0.136X6 +0.132X7- 0.133X8 + 0.957X9 + 0.095X10 - 0.435X11- 0.007X12 + 0.115X13; where Xi –represents independent variables e.g., plant height, trunk girth, canopy spread(E-W), canopy spread(N-S), number of flowering laterals/m^2, number of staminate flowers, number of perfect flowers, number of total flowers, sex ratio, nut weight, kernel weight, apple weight and number of nuts/panicle respectively.

A higher magnitude of R^2-value (0.8030) indicated that at least 80% of the phenotypic variation is explained by the yield component traits under investigation. Regression co-efficients of canopy spread (N-S) and number of flowering laterals/m^2 were found significant at 1% level of significance while, plant height and number of nuts/panicle revealed significant value at 5% level of significance indicating that these four component traits have definitely predominant influence on nut yield in cashew nut. In this context, Lingaiah *et al*.[15] showed that number of nuts/panicle and mean number of perfect flower/panicle are the important component traits for nut yield following regression studies of eleven yield contributing character in cashew. However, such a comparison of characters based on estimates of the partial regression co-efficients has no meaning as b-values are in fact not unit free. Therefore, overall mean value of each component traits was multiplied with respective b-value and expressed in terms of yield units. The relative magnitude of these products may be considered for logistic comparison among component characters towards contribution for nut yield. On verification of the product values, it was revealed that number of perfect flowers (NPF) followed by canopy spread (N-S), number of flowering laterals/m^2, canopy spread (E-W) and plant height had high contribution for expression of nut yield. In contrast, kernel weight, apple weight and total number of flowers (staminate and perfect flowers) revealed negative Y-hat component values.

Table 1: Regression analysis of yield component traits on nut yield of cashew

Estimates of regression	a-value	PHT	TG	CS (E-W)	CS (N-S)	FL/ m^2	NSF	NPF	TF	SR	NW	KW	AW	N/P
b-value	4.976	0.266*	0.006	0.273	0.614**	0.092**	0.13	0.132	-0.133	0.975	0.095	-0.435	-0.007	0.115*
SE (b)	0.985	0.128	0.009	0.169	0.153	0.025	0.14	0.139	0.139	2.858	0.103	0.275	0.005	0.056
Y-hat components	-	1.096	0.341	1.099	2.578	1.528	0.45	10.53	-58.45	0.215	0.745	-1.046	-0.427	0.547
t-value of b		2.078	0.666	1.615	4.013	3.680	0.07	0.95	0.956	0.341	0.922	1.582	1.400	2.053
Regression equation	Y(Nut yield)= 4.976 + 0.266X_1 + 0.01X2 + 0.273X3 + 0.614X4 + 0.092X 5 + 0.136X6 +0.132X7- 0.133X8 + 0.957X9 + 0.095X10 - 0.435X11- 0.007X12 + 0.115X13													

b-Partial regression co-efficient *, **- Significant at $p_{0.05}$ and $p_{0.01.}$ R^2= 0.8030 PHT-Plant height(cm), TG-Trunk girth(cm), CS(E-W): E-W canopy spread(m), CS(N-S): E-W canopy spread(m), FL/ m^2-Flowering laterals/m^2, NPF-No. of perfect flowers/m^2, NSF-No. of staminate flowers/m^2, TF-Total no. of flowers/m^2, SR-Sex ratio, NW-Nut weight(g), KW-Kernel weight(g), AW-Apple weight(g), N/P-No. of nuts/panicle, NY-Nut yield(kg/plant)

Table 2: Performance of five top yielding cashew hybrids and their parents for 14 morpho-economic traits

Geno-types	Cross combination	PHT	TG	CS (E-W)	CS (N-S)	FL/ m^2	NSF	NPF	TF	SR	NW	KW	AW	N/P	NY (ton/ha)
D- 19	M44/3 x VTH 711/4	4.36	66.56	4.30	4.45	20.03*	345.53	106.43	445.06	0.313	9.47*	2.88	89.0*	5.74	2.71*
H- 6	M44/3 x KBN	4.36	69.11	4.68	4.91*	18.79	510.89	87.56	598.51	0.175	7.33	2.34	55.25	5.82	2.67*
B- 27	RP 1 x VTH 711/4	4.81*	65.96	4.07	4.65*	20.45*	384.07	117.5	501.42	0.302	8.60	2.87	73.02	6.08*	2.58*
A- 71	RP 1 x KBN	4.67*	63.23	4.37	5.22*	22.87*	252.57	67.0	319.42	0.262	7.5	2.58	68.82	7.73*	2.52*
G- 8	RP 2 x KBN	4.28	64.68	4.40	4.69*	18.27	386.03	104.93	527.06	0.363*	7.13	2.23	45.96	8.02*	2.49*
RP 1	Parent	3.35	50.67	3.57	3.91	16.24	418.16	85.33	503.66	0.203	6.17	2.00	42.63	6.85*	1.56
RP 2	-do-	3.49	57.98	3.74	3.97	16.47	353.50	99.00	452.66	0.283	6.44	2.17	41.54	7.43*	1.45
KBN[a]	-do-	3.35	50.22	3.82	4.07	13.25	252.83	15.41	268.33	0.063	9.31*	2.53	54.95	3.09	1.15
VTH711/4	-do-	4.07	70.91	4.26	4.45	14.36	366.33	47.91	414.33	0.130	12.84*	3.88*	149.8*	2.99	1.10
M 44/3	-do-	2.77	54.19	3.57	3.52	17.37	252.00	103.33	353.33	0.417*	5.32	1.56	42.35	7.99*	1.60
BPP 8[b]	Standard check	**3.86**	66.87	4.17	4.05	16.18	426.5	106.1	532.50	0.250	7.52	2.17	67.98	4.39	1.97*
BH 6	-do-	3.41	55.83	3.35	3.98	14.68	277.5	38.1	315.83	0.137	8.45	2.69	63.97	4.07	1.41
BH 85	-do-	3.39	55.77	3.56	4.20	15.31	313.1	80.8	394.00	0.260	7.68	2.33	64.59	5.10	1.65
	C.D.$_{0.05}$	0.57	5.7	0.6	0.4	2.8	93.8	14.8	98.9	0.100	0.6	0.2	5.6	1.1	0.28

*- Significant at $p_{0.05}$ [a]KBN: Kalyanpur bold nut [b]BPP 8: best standard check

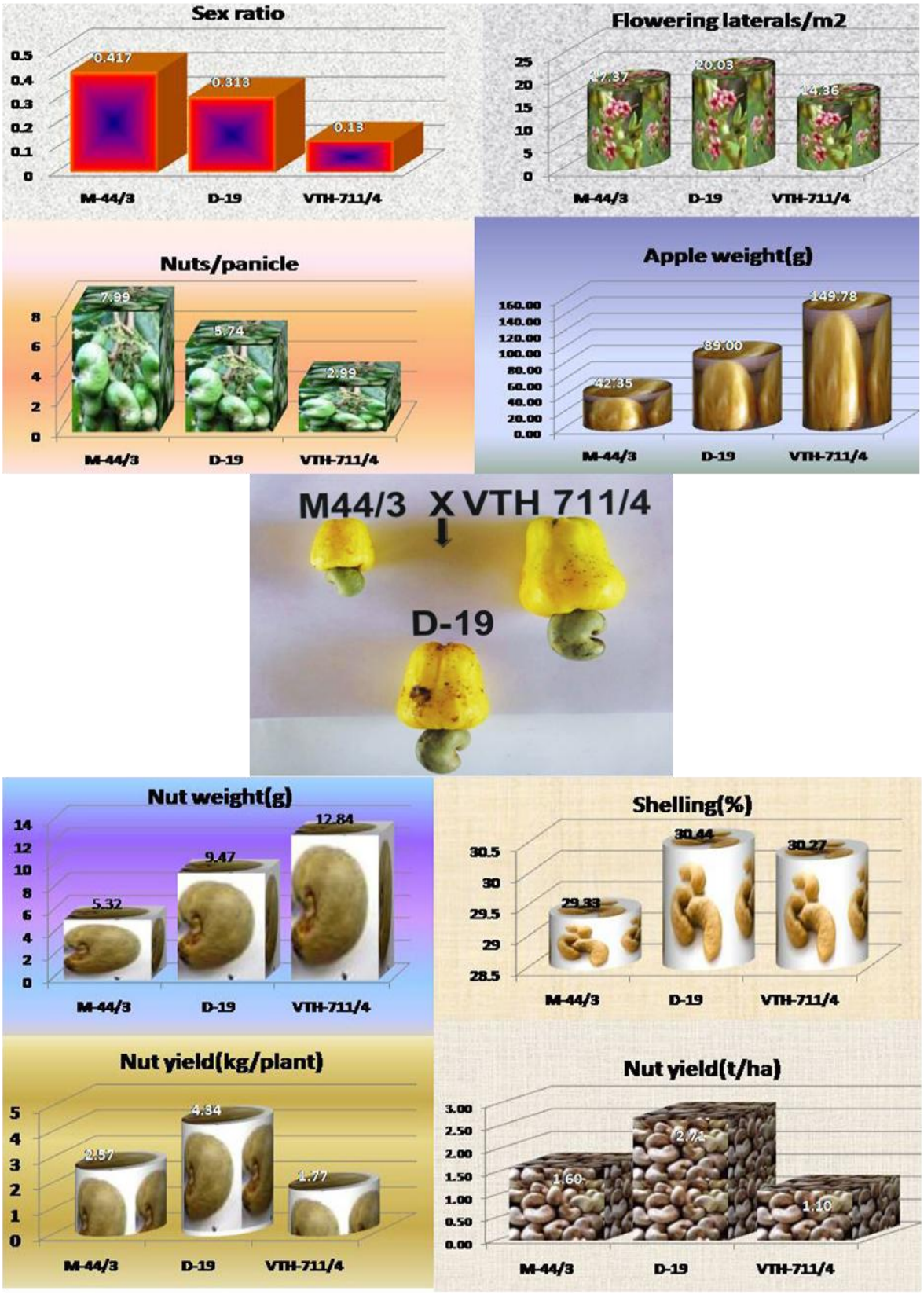

Figure 1: Nut yield and important ancillary traits of cashew hybrid D 19 and its parents

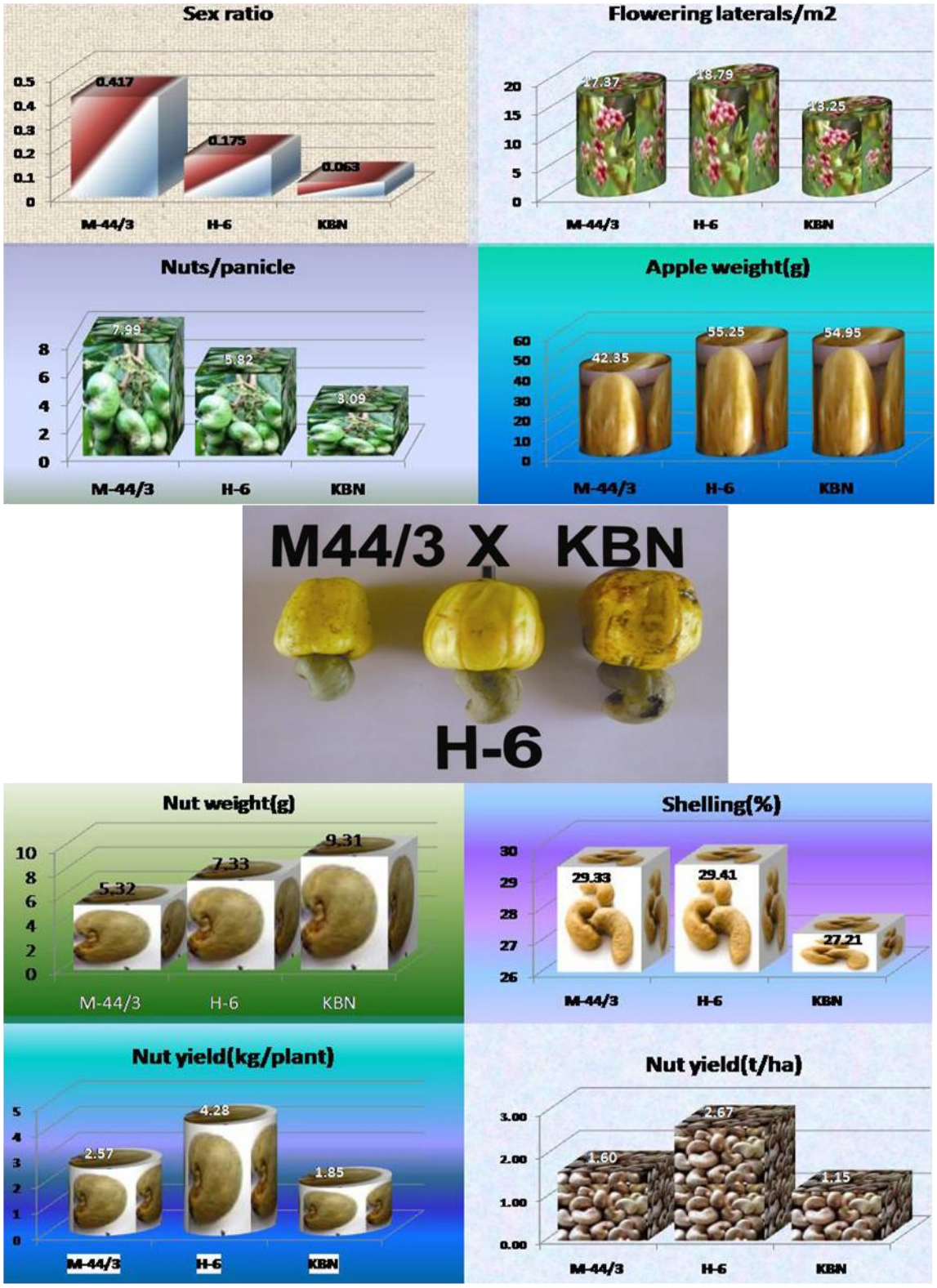

Figure 2: Nut yield and important ancillary traits of cashew hybrid H 6 and its parents

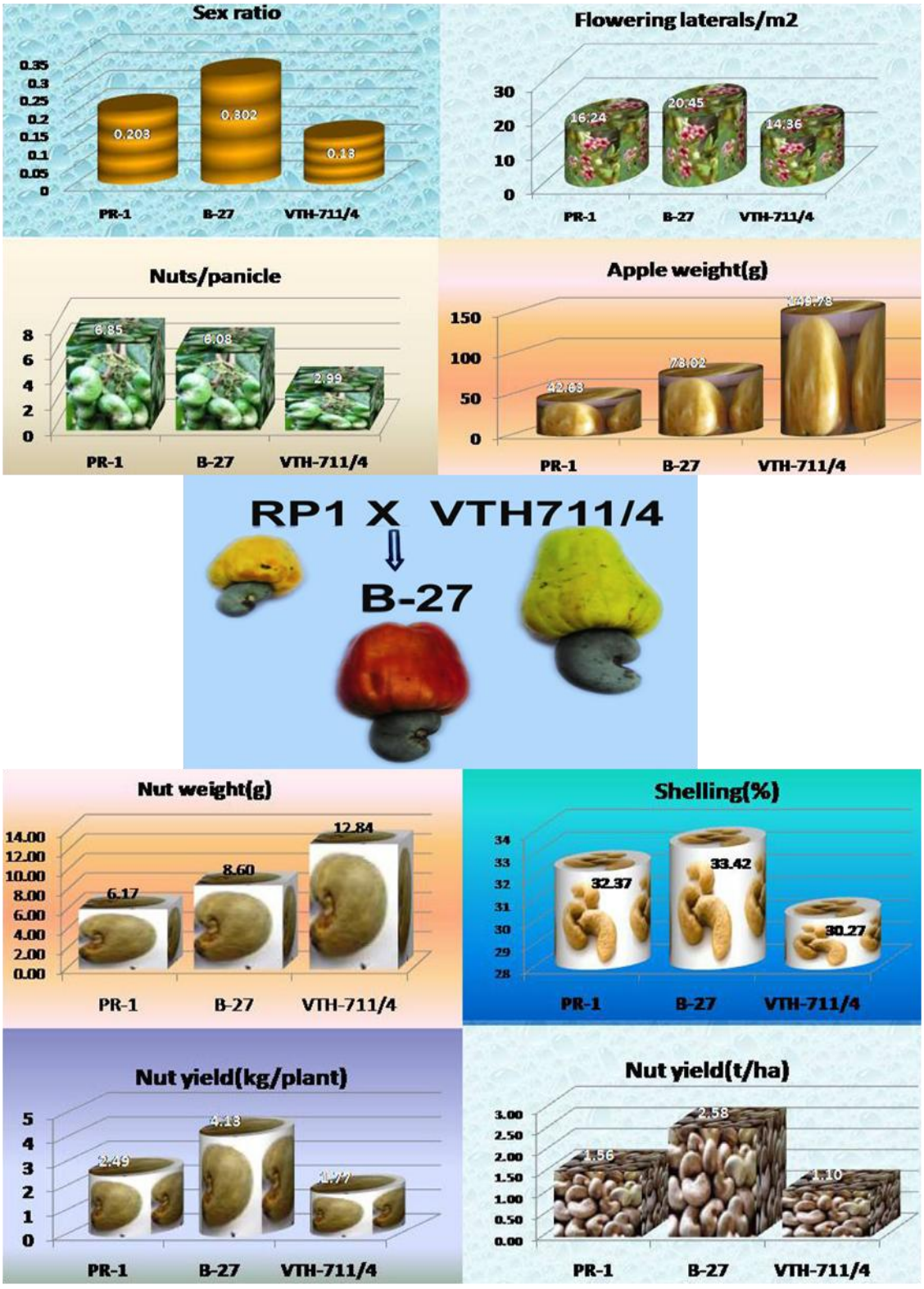

Figure 3: Nut yield and important ancillary traits of cashew hybrid B 27 and its parents

Therefore, selection should be done meticulously in such a way that selection for different characters in positive direction would compensate the yield loss due to other traits that influence negatively. Keeping in view above findings, all the cashew genotypes were ranked based on above individual important yield contributing traits and rank total of each genotype was considered as the selection criteria to judge over all merit for productivity. It was found that the top ranking cashew nut test genotypes based on above selection criteria are the most promising hybrids compared to their

parents involved. These include top yielding hybrids e.g., D 19, H 6, B 27, A 71 and G 8 (Table 2) followed by H 8, C 30, A 48, J 12, C 41, J 20 and J 6. A perusal of Figure 1 to Figure 3 represented performance of three most promising cashew hybrids (D 19, H 6 and B 27) for important agro-economic traits including nut yield.

In the present investigation, performance of each genotype short listed in Table 2, was compared with a standard check variety that performed best among the checks for the morpho-economic trait concerned. BPP 8 was found to be the best standard check variety for nut yield as it significantly out yielded BH 6 and BH 85(Table 2). None of the parental genotypes had shown superiority over BPP 8, but the promising cashew hybrids identified in this investigation significantly excelled (>2.5ton/ha) in nut yield. The top yielding hybrid D 19 revealed significantly higher number of flowering laterals and nut weight. Dorajeerao *et al.* [16] observed maximum 21.25 flowering laterals/m2 under Bapatla (A.P., India) condition while Samal *et al*.[17] observed the flowering laterals of 11.62 to 24.88 in different cashew types under Bhubaneswar (Odisha) condition. High yield potential of two cashew hybrids e.g, B27 and A 71 could be attributed to taller plant type with significantly more canopy spread (both East-West and North-South) and higher number of flowering laterals/m2 and nuts/panicle. On the other hand, the merit of cashew hybrid H 8 was evidenced from canopy spread (North-South), sex ratio and number of nuts/panicle. The above elite cashew hybrids with significantly high nut yield potential may be utilized as potential donors in future breeding programme. Besides, such heterotic hybrids may be considered for large scale multiplication and follow-up commercial cultivation.

Conclusion

Regression analysis of ancillary traits followed by estimation of their Y-hat components can be useful to identify major yield contributing traits. Thereafter, ranking the genotypes based on each important yield determining traits and rank total of each genotype may be considered as the selection criteria to judge over all merit for productivity.

References

1. Saroj P.L., Krishna Kumar N.K. and Janakiraman T., Converting wastelands into goldmine by cashew cultivation. Indian Horticulture (Nov. –Dec.,2014), 49-56 **(2014)**

2. Rao E.V.V.B. and Swamy K.R.M., Genetic resources of cashew. In: K.L. Chadha and P. Rathinam (Eds.) Advances in Horticulture Vol. 9, Plantation and Spice Crops, Part I pp. 79-97, Malhotra Publishing House, New Delhi **(1994)**

3. Cavalcanti J.J.V., Diallel analysis to evaluate inter populational cashew tree hybrids, Pesqisa Agropecuaria Brasileir, 35(8), 1567-1575 **(2000)**

4. Singh L.S., Poduval M., Medda P.S., Pariari A. and Bhattacharjee H., 2008, Flowering behaviour of six varieties of cashew under tarai agroclimatic zone of West Bengal, The Cashew, 12(2), 5-10 **(2008)**

5. Dasmohapatra R., Rath S. and Pattnaik A.K., Performance of cashew entries/varieties under eastern coastal plain of Odisha, Environment and Ecology, 30(3A), 770-772 **(2012)**

6. Sethi K., Studies on morphological and molecular diversity in cashew (*Anacardium occidentale* L.) hybrids, Ph.D. Thesis, Department of Fruit Science and Horticulture Technology, College of Agriculture, OUAT, Bhubaneswar, India, 43 **(2015)**

7. Sethi K., Lenka P.C., Tripathy S.K. and Mohanty P., Assessment of molecular genetic diversity and identification of elite cashew hybrids, Int. J. Hort., 6 (2), 1-10 **(2016)**

8. Ferriera-Silva S.L., Voigt E.L., Viegas R.A., Paiva J.R. and Silveira J.A.G., Influentia de porta-enxertos na resistancia de mudas de casueiro ao estresse salino, Pesquisa Agropecuaria Brasileira, 44(4), 361-367**(2009)**

9. Masawe P.A.L., Aspects of breeding and selecting improved cashew genotypes (*Anacardium occidentale* L.), Thesis, University of Reading, UK, 50 **(1994)**

10. Swamy K.K.M., Bhaskar Rao E.V.V. and Bhat M.G., Catalogue of minimum descriptors of cashew, Germplasm-II, National Research Centre for Cashew (ICAR), Puttur, Karnataka, India p. 54 **(1998)**

11. Panse V.G. and Sukhatme P.V., Statistical methods for agricultural workers, IARI (ICAR), New Delhi, 15-67 **(1985)**

12. Singh R.K. and Choudhury B.C., Biometrical Techniques in Genetics and Plant Breeding. International Bioscience Publisher, India, 63-68 **(1985)**

13. Grafius J.E., Components of yield in oats- a geometric interpretation, Agron J., 48, 419-423 **(1956)**

14. Grafius J.E., A geometry of plant Breeding, Crop Science, 4, 241-246 **(1964)**

15. Lingaiah H.B., Reddy, S and Lkarni, R.N.S., Genetic divergence in cashew genotypes, PLACROSYM - XII(University of Agricultural Sciences, Bangalore), 28-33 **(1996)**

16. Dorajeerao A.V.D., Ravisankar C. and Reddy M.L.N., Morphological and yield characters of certain promising clones of cashew nut under Bapatla conditions, South Indian Horticulture, 50(1/3), 151-158 **(2002)**

17. Samal S., Evaluation of genetic relationship and variability in cashew (*Anacardium occidentale* L) through morphological, biochemical and molecular analysis. Ph. D. Thesis, Utkal University India **(2002).**