

STABILITY OF PERFORMANCE OF ARECANUT VARIETIES OVER YEARS

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ABSTRACT

A joint regression analysis for weight and number of nuts in arecanut was conducted. Significant differences between varieties as well as between years for weight of nuts were observed. The regression coefficients of the varietal means over year means in most cases were significant. Differential response to varying environmental values was observed between the varieties. The highest yielding varieties 'VTL. 11', 'VTL. 17' and 'VTL. 29d' were found to be suitable for planting under favourable environments only, 'VTL. 12' and 'VTL. 29a' with fairly high yield showed stability in performance also.

An ideal crop variety is one that has a high mean yield but a low degree of fluctuation in performance when grown over diverse environments. Hence testing for stability in performance has become an important item of work in most plant breeding programmes. Assessment of stability in a plantation crop like arecanut is difficult because the crop comes to bearing only after about five years and hence requires a long term planning to carry out the work. Moreover, it is difficult to repeat the experiments over several locations for want of adequate area for a crop like arecanut with a long breeding cycle. However, if yearwise yield data are available for a set of varieties, such data can be analysed taking years as environments. The results of such an analysis in arecanut is reported in this paper.

MATERIALS AND METHODS

Data on weight of nuts as well as number of nuts per tree were obtained from two experiments each with six replications. The individual plots had a single tree in an area of 7.29 sq.m. Thirteen varieties were tested in Experiment I and 11 in Experiment II. Data were available for eight years (1969-76) in Experiment I and for nine years (1969-77) in Experiment II. Taking years as environments, the data were subjected to a joint regression analysis of the model proposed by Perkins and Jinks (1968).

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## RESULTS AND DISCUSSION

The joint regression analysis showed that there were significant differences between the varieties as well as between the environments for weight of nuts in both the experiments (Table 1). With regard to the number of nuts, the environmental differences alone were significant in Experiment II. Arecanut being a seed-propagated, cross-pollinated crop, the individual trees of a variety in different replications are

TABLE 1  
Mean squares from joint regression analysis for weight and number of nuts in arecanut

Source	Experiment I			Experiment II		
	d. f.	Weight	Number	d. f.	Weight	Number
Varieties	12	184.64**	180760	10	133.19**	48997
Environments	7	170.04**	192398	8	218.42**	136454**
Varieties × Environments	84	14.47	13172	80	12.19	7623
Heterogeneity between regressions	12	35.16**	26432	10	30.79**	13265**
Deviations	72	11.02	10962	70	9.53	6817
Within variety, pooled		60.00	304108		58.47	44959

\*\* Significant at  $P=0.01$

heterogeneous to varying degrees. In such a situation, estimation of within variety variance only is possible which is not a correct estimate of random error in the experiments. Hence interaction mean squares could not be tested precisely.

The variety x environment interaction sums of squares were partitioned into that due to heterogeneity of regressions and deviations. The mean squares due to heterogeneity of regressions were found to be highly significant for weight as well as number of nuts in both the experiments, indicating that a larger part of varietal response is a linear function of environmental values. This facilitates selection of varieties for high yield and for stability in performance expressed by unit regression coefficient.

The mean yields, the regression mean squares and the regression coefficients are given in Table 2. In a few varieties, the regression mean squares were not significant indicating the non-linear response of the varieties concerned over the environmental values. In the other varieties, where there was linearity in response, the regression coefficients were significantly different from unity as in the case of 'VTL. 11', 'VTL. 17' and 'VTL. 29d' for weight of nuts. These were also the highest yielding varieties. These varieties can be regarded as highly sensitive to environments because of their greater than unity regression coefficient and hence are suitable for planting under favourable environments only. Among other varieties with unit

TABLE 2

*Varietal means, regression mean squares and regression coefficients for weight and number of nuts*

Variety	Weight of nuts (kg./tree)			Number of nuts/tree		
	Mean (Kg./tree)	Regression mean square	Regression coefficient	Mean (No./tree)	Regression mean square	Regression coefficient
<i>Experiment I</i>						
VTL. 11	18.27	294.50**	1.80 <sup>a</sup> ±0.31	663	290963**	2.02 <sup>a</sup> ±0.36
VTL. 17	16.59	489.69**	2.32 <sup>a</sup> ±0.39	397	400877NS	—
VTL. 12	15.17	186.41*	1.43 <sup>b</sup> ±0.46	411	83134*	1.08 <sup>b</sup> ±0.45
VTL. 14	13.07	72.64*	0.89 ±0.29	471	78067NS	—
VTL. 3	12.57	72.80*	0.89 <sup>b</sup> ±0.29	346	44455*	0.79 <sup>b</sup> ±0.29
VTL. 13	11.31	174.95*	1.38 <sup>b</sup> ±0.49	316	93568*	1.15 <sup>b</sup> ±0.45
VTL. 5	9.51	24.24NS	—	318	78588**	1.05 <sup>b</sup> ±0.42
VTL. 15	7.77	159.94**	1.32 <sup>b</sup> ±0.30	153	47902*	0.82 <sup>b</sup> ±0.22
VTL. 18b	7.33	58.63**	0.80 <sup>b</sup> ±0.21	243	55607*	0.89 <sup>b</sup> ±0.27
VTL. 18c	4.89	7.04*	0.28 ±0.09	208	11847NS	—
VTL. 1	4.83	2.47NS	—	239	3549NS	—
VTL. 18a	3.50	30.67**	0.58±0.10	117	42566**	0.77 <sup>b</sup> ±0.20
Local	14.39	38.15NS	—	476	9661NS	—

(Contd.)

(Table 2 Contd.)

Variety	Weight of nuts (kg./tree)			Number of nuts/tree		
	Mean (Kg./tree)	Regression mean square	Regression coefficient	Mean (No./tree)	Regression mean square	Regression coefficient
<i>Experiment II</i>						
VTL. 29d	18.93	655.65**	2.03 <sup>b</sup> ± 0.20	440	349647**	1.88 <sup>a</sup> ± 0.18
VTL. 29a	14.64	156.80**	0.99 <sup>b</sup> ± 0.16	382	68695**	0.83 <sup>b</sup> ± 0.19
VTL. 28a	13.30	85.60NS	—	375	49973NS	—
VTL. 28b	12.58	316.16**	1.41 <sup>b</sup> ± 0.30	307	184435**	1.36 <sup>b</sup> ± 0.29
VTL. 29f	12.55	211.20**	1.15 <sup>b</sup> ± 0.17	325	133539**	1.16 <sup>b</sup> ± 0.28
VTL. 29b	11.09	208.46**	1.15 <sup>b</sup> ± 0.28	290	104701**	1.03 <sup>b</sup> ± 0.25
VTL. 29e	10.26	76.38**	1.15 <sup>b</sup> ± 0.17	266	37833*	1.62 <sup>b</sup> ± 0.21
VTL. 28c	9.88	111.54*	0.84 <sup>b</sup> ± 0.26	283	46095*	0.68 <sup>b</sup> ± 0.27
VTL. 26	7.13	21.69*	0.40 <sup>b</sup> ± 0.13	351	81401*	0.91 <sup>b</sup> ± 0.31
VTL. 29c	6.81	111.70*	0.84 <sup>b</sup> ± 0.32	210	104171**	1.02 <sup>b</sup> ± 0.17
Local	5.75	99.26*	0.79 <sup>b</sup> ± 0.27	196	63784*	0.80 <sup>b</sup> ± 0.26

NS — Not significant.

\* — Significant at P = 0.05

a — Significantly different from unity.

b — Not significantly different from unity.

\*\* — Significant at P = 0.01

regression coefficients for weight of nuts, 'VTL. 12' and 'VTL. 29a' were fairly high yielding with more than 14 kg. of nuts per tree. These can be considered to be stable yielders under all environments. There were a few other varieties with unit regression coefficients but having slightly less yields. The performance of all the varieties with regard to number of nuts was more or less of the same pattern as in the case of weight of nuts. However, it has to be noted that the above findings will hold true only when the individual trees within a variety are subjected to *inter se* mating during seed production process because of high within family variance.

#### REFERENCE

- Perkins, J M. AND J. L Jinks (1968) Environmental and genotype-environmental components of variability. III. Multiple lines and crosses. *Heredity*, 23 : 339-356.