Genetic Variability of Coffee (*Coffea arabica* L.) Germplasm in biennial bearing and its impact on selection efficiency

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Introduction

Coffee is a perennial cash crop and consists of 124 species (Davis et al., 2011). From coffee species, Arabica coffee is highly affected by biennial bearing and yield is higher one year and lower the next (Joao and Ana, 2018); this affects farmers' annual incomes, world's coffee industry and selection efficiency. So far no study was conducted to test variability among Arabica coffee Germplasm in biennial bearing and its effect on advanced selection. Objectives: to evaluate variability among Arabica coffee in bienniality and to identify its effects on selection efficiency.

Materials and Methods

The study was conducted at Gera (high land) and Tepi (low land). A total of 88 coffee accessions were involved in this study. Genetic variability was analyzed using R-software (vers. 4.3). Bienniality computed according to Hoblyn et al. (1936).

Results

Table 1. Genetic parameters and variability in yield and biennial bearing

Loc.	GP	2016	2017	2018		2019		2020		Mean
		YLD	YLD	I2	YLD	I3	YLD	I4	YLD	I5	YLD
Tepi	GCV	18.4	22.78	33.76	13.55	24.7	29.95	16.86	37.9	16.88	17.57
	PCV	45.04	48.8	37.93	54.64	30.71	37.77	24.67	40.24	24.43	35.51
	GA	89.23	198.1	0.18	66.56	0.08	228.9	0.06	504.8	0.07	128.7
	GAM	15.41	21.79	61.6	6.89	40.71	48.7	23.62	73.18	23.92	17.81
	H	16.69	21.78	79.22	6.15	64.65	62.9	46.71	88.71	47.75	24.46
	CV%	41.11	43.16	17.29	52.94	18.26	23	18.01	13.52	17.66	30.87
	F-test	ns	ns	**	ns	ns	ns	ns	**	ns	ns
Gera	GCV	-	11.6	24.49	14.12	19.89	12.64	18.02	26.69	-	14.48
	PCV	-	17.31	44.46	29.24	33.11	28.49	29.54	33.08	-	20.84
	GA	-	229.0	0.1	104.1	0.1	250.9	0.081	909.2	-	331.4
	GAM	-	16.01	27.66	14.05	24.5	11.54	22.54	44.36	-	20.73
	H	-	44.9	30.35	23.32	36.09	19.67	37.22	65.11	-	48.28
	CV%	-	25.69	74.21	51.2	52.94	51.08	46.8	39.08	-	29.97
	F-test	-	ns	ns	ns	ns	ns	ns	*	-	*

GP-Genetic parameters, P&G-CV-phenotypic &genetic coefficient of variation respectively, GA-genetic advance, H-heritability, YLD-Yield, I-Biennial bireaning Inndex (eg I2-between 2016 & 2017, I3- between 2017 & 2018 etc.. CD-Critical difference, GAM- Genetic advance as percentage of mean

Table 2. Biennial bearing and line selection at Tepi

Acce.	Rank(2 yrs)	RP1	Rank (3yrs)	PR2	Rank(4yrs)	RP3	Rank (5yrs	RP4	I
T-21	15	0.23	15	11.9	15	28.8	10	47.9	0.2
T-22	14	79.2	8	5.88	7	39.3	7	28.9	0.4
T-36	13	63.3	7	10	8	49.5	6	44.9	0.4
T-37	2	45.5	4	11.1	4	46.8	1	56.2	0.4
T-38	5	64.6	11	22.2	10	43.6	2	66.9	0.5
T-40	1	73.8	3	33.3	3	40.4	4	39.3	0.5
T-41	7	10.7	6	26.4	6	56.4	8	28.8	0.3
T-42	4	56.1	2	4.76	2	35	5	43.3	0.4
T-43	3	9.16	1	15.8	1	22.1	3	49	0.2
T-51	12	9.78	5	36.1	5	51.7	9	4.66	0.3
<10hy	70%		80%		90%		100 %		

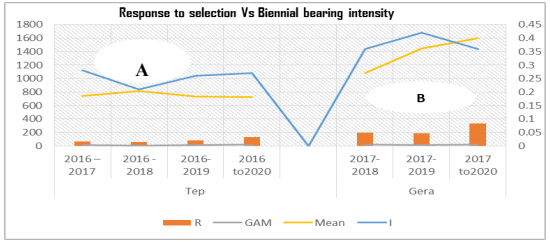

Figure 1. Response to selection vs Bienniality; at Tepi (A) and Gera(B)

Table 3. Biennial bearing and selection of promising lines at Gera

Acce.	Rank (2YRS)	RP1	Rank (3YRS)	RP2	Rank (4YRS)	RP3	I
T-50	16	2.24	23	32.1	1	52	0.3
T-78	1	82.9	1	81.5	2	8.7	0.6
T-80	11	5.34	14	40.9	3	29	0.3
T-53	5	39	4	56.2	4	6.2	0.3
T-39	46	39.6	8	76.2	5	20	0.5
T-38	23	18.2	37	32.9	6	38	0.3
T-70	12	58.7	10	72.9	7	17	0.5
T-60	2	0.79	2	8.33	8	22	0.1
T-43	6	21.9	15	36.6	9	6.9	0.2
T-85	8	42.2	5	59.3	10	24	0.4
T-67	83	8.21	7	80.4	11	39	0.4
T-64	15	39.9	19	54.8	12	9.1	0.4
T-51	9	13.1	3	49.4	13	35	0.3
T-59	26	33.2	30	51.7	14	18	0.3
<15hy	66%		66.7%		100%		

Rank-(2-5YRS) - Ranks of the top 10 (at Tepi) and 15 (at Gera) genotypes using mean of over two, three, four and five years, RP1-4 – Relative percentage bienniality between consecutive years, ≤15 HY in % - The top 15 high yielder in percentage and I-Biennial intensity

Conclusion

Variability was observed among coffee accessions in yield performance and biennial bearing. Alternate bearing could affect response to selection which lead to less selection efficiency. Early selection, before four harvesting seasons excluded 30-40% high yielders from advanced selection. Selection at four harvesting seasons revealed 90% and more selection efficiency which is ideal for promising line selection. In general, one has to be cognizant the biennial bearing nature of Arabica coffee during advanced selection.

References

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