



Relationship between Seedling Vigour and Mature Plant Traits in Some Castor (*Ricinus communis* L.) Accessions and Their F1 Hybrids

Akombo, R.A.¹; Adeyemo, M.O.²; Odiaka, N.I.²; Aliyu, D.J.³

^{*1} Department of Crop Production Technology, Akperan Orshi College of Agriculture Yandev, PMB 181 Gboko, Nigeria.

² Department of Crop Production University of Agriculture, Makurdi, PMB 2373 Makurdi, Nigeria.

³ Department of Agricultural Technology, College of Agriculture, Lafia, Nasarawa State, Nigeria.

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ABSTRACT

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***Corresponding Author**

Akombo, R.A.

E-mail: akomborich@yahoo.com

Phone: 08038289185

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Seven castor accessions were subjected to diallel crossing without reciprocal in 2008. The seven parents and their 21F1 hybrids were evaluated in Makurdi and Yandev both in Nigeria in 2009 in a Randomized Complete Block Design (RCBD) replicated 3 times to obtain data on seedling vigour, yield and yield related traits in the crop seedling emergence data which were recorded on the whole plot at two-day intervals and used to compute emergence percentage (E%), emergence index (EI) and emergence rate index (ERI). Data on days to flowering, days to maturity, plant height, number of branches per plant, number of panicles per plant, 100-seed weight and seed yield per hectare on the middle row of each plot. Coefficient of linear correlation were computed for each pair of traits for the seven parents (accessions) and their 1 hybrids separately and the combination of parents and hybrids. Different patterns of correlation were observed among traits of castor accessions, the hybrids and the parents and hybrids combined.

INTRODUCTION

The castor bean plant (*Ricinus communis* L.) is an important oil seed crop. Locally, it is used mainly for herbal medicine in Nigeria especially in the Northern part of the Country. However, the crop is universally important for its industrial products in many sectors of

the world's economy. The oil is used in medicine and constitutes an important ingredient in cosmetics, lubricants, paints and disinfectants. Raymond (1961) reported the use of castor seeds for "Igili-Isi" in Onitsha or "Ogili-Ugba" in Awka, Anambra state for West Africa after boiling and fermentation.

Many research works have been done on castor by several researchers such as Hook *et al.*, 1971; Uguru, (2000) including correlation among mature plant traits in castor. There is dearth of information regarding the correlation of seedling vigour with mature plant traits especially in castor. It was against that background that this work was conducted to (i) study the relationship between seedling vigour and mature plant traits among some castor accessions with a view on whether they can be improved upon simultaneously.

MATERIALS AND METHODS

Seven castor bean plant accessions were planted in the Teaching and Research Farm of University of Agriculture Makurdi, Nigeria for diallel crossing in December, 2007 and raised under irrigation until March, 2008 when the first rain was experienced. The accessions were for the purpose of this research coded 1, 2, 3, 4, 5, 6 and 7. The diallel cross was carried out using brown envelopes to cover the panicles before the flowers opened. For selfing of parent materials, the panicles were covered with all the floral parts intact while for plants earmarked for crossing, the floral buds were removed before the

panicles were covered. The latter were hence designated as females.

Emasculation of the male flower was achieved with the use of finger and thumb. Pollen grains were collected from fully opened male flowers. The covered panicles opened each at a time and the female flower dusted with the pollen grains. During this process, the interspersed male floral buds were removed and the panicles covered back.

The 7 parents and the 21 F₁s were evaluated in two locations (Makurdi and Yandev) which are on 7°44'N, 9°3'E and 7.4°N, 8.7°E respectively, while elevations for Makurdi and Yandev were 104m and 315m respectively. The evaluation was laid out in a Randomized Complete Block Design (RCBD) with three replications. Each plot was made up of three rows of 2m length and spaced 1m apart. Hills within a row were spaced 0.5m apart. Each hill was sown with two seeds and the seedlings were thinned to one plant per hill at four weeks after emergence. Data were taken on the three plants in the middle row of each plot except for the emergence data. Cultural practices as recommended for the production of castor were followed.

Emergence data were collected by counting the number of seedlings that emerged at two-day intervals for 8 weeks after planting on the whole plot. They were used to compute:

- (i) Emergence percentage (E %) = $\frac{\text{Total number of seedlings that emerged}}{\text{Total number of seeds planted}}$
- (ii) Emergence Index (EI) = $\sum \frac{(\text{number of seeds that emerged in a day})(\text{days after planting})}{\text{Total number of seedlings that emerged}}$
- (iii) Emergence Rate Index (ERI) = $\frac{EI}{E\%}$

Data on other traits listed below were collected on three plants in the middle row. They included:

Days to Flowers: This was determined as the mean number of days from planting to flowering of the panicles on the three competitive plants.

Days to Maturity: This was determined as a mean number of days from planting to the first noticeable sign of the capsules on the primary panicle turning brown.

Plant Height: This was determined as the mean height from the soil surface to the node bearing primary panicle at 20 weeks after planting.

Number of Branches: This was determined as the mean number of branches on the three sampled plants at 20 weeks after planting.

Hundred-Seed Weight: This was determined as the mean weight of 100 selected healthy seeds from the three selected plants using Triple Beam Balance, 700 series.

Seed Yield per Hectare: The product of the mean seed yield per plant and 10000m² divided by intra-row spacing and number of plants per hill.

Means of various traits were computed for parents and hybrids. Pearson product moment correlation coefficients were also computed to determine the relationship between seedling vigour and mature plant traits in parents, hybrids and a combination of the two.

RESULTS AND DISCUSSION

Genotype means of the traits quantified in some castor accessions and their hybrids for the two locations (Makurdi and Yandev) combined are presented in Table 1. The data show that parent means tended to be higher than hybrid means in days to flowering, days to maturity, 100-seed weight and emergence percentage, whereas hybrid means tended to be higher than parent means in plant height, number of branches, number of panicles per plant, seed yield per hectare, EI and ERI. Similar performance in 1,2,3, etc traits in maize were reported and attributed to heterosis by Ogunbodede *et al.* (2000).

Coefficients of correlation are presented in Tables 2, 3 and 4 for parents, hybrids and a

combination of parents and hybrids, respectively. The data revealed significant positive correlation of days to flowering with days to maturity, number of branches with number of panicles per plant and seed yield per hectare in all the three sets of materials studied. The associations among some of these traits are desirable as earliness/lateness to maturity synonymous with earliness/lateness to flower. In a like manner, the association of the number of branches per plant with number of panicles per plant is expected as each branch of castor plant ends up in the production of a panicle. The consistency of a particular pattern of correlation and the materials used is an indication of

non-confounding effect and hence any of the materials could be used in studying correlation.

The correlation between one trait and another is an indication that the two traits could be improved upon simultaneously. For instance, the highly significant positive correlation of days to flowering with days to maturity is beneficial as lowering days to flowering will lead to earliness to maturity. The negative significant correlation in days to flowering with seed yield per hectare confirmed an earlier report by Hooks *et al.* (1971) that seed yield and oil content were negatively correlated with days to flowering.

TABLE 1: GENOTYPIC MEANS OF SOME TRAITS QUANTIFIED FROM DIALLEL ANALYSIS IN SEVEN SELECTED CASTOR ACCESSIONS (MAKURDI AND YANDEV COMBINED)

Genotype	DTF	DTM	PHT	NOB	NPPP	SY	Swt100	E%	EI	ERI
Parents										
1	78.33	117.44	54.05	2.58	6.38	7637.67	9.42	25.17	13.95	56.74
2	70.50	112.11	51.67	2.72	4.67	761.20	10.88	9.17	19.15	224.29
3	85.73	115.83	41.55	2.72	3.98	404.67	10.81	10.83	16.63	199.09
4	74.67	111.67	43.00	3.10	5.33	341.87	9.67	19.83	13.99	83.20
5	71.67	112.50	43.50	1.83	3.23	405.53	9.68	22.50	12.37	54.98
6	71.33	109.67	48.22	2.55	5.55	660.47	11.03	20.67	16.94	81.95
7	72.33	112.17	41.00	2.95	6.63	595.80	9.72	18.33	17.14	98.91
Mean	74.94	113.06	46.14	2.64	5.11	557.80	10.17	18.07	15.74	144.17
Hybrids										
1x2	73.83	113.50	49.12	1.73	3.72	302.20	8.75	19.17	18.60	101.51
1x3	77.17	117.50	56.57	1.75	3.67	524.66	10.00	12.33	20.40	164.56
1x4	67.09	111.99	50.84	2.23	4.38	279.46	9.64	18.17	20.77	122.75
1x5	60.17	109.17	49.65	3.07	6.77	759.33	9.85	12.33	18.65	218.15
1x6	82.17	116.11	53.25	3.45	7.40	914.66	10.57	22.83	18.04	86.21
1x7	68.50	110.00	52.05	2.55	4.78	748.66	9.63	18.50	15.39	110.14
2x3	73.00	114.75	56.23	2.52	4.30	338.00	10.32	17.16	14.95	97.82
2x4	81.77	112.61	42.49	2.59	5.18	935.46	10.19	14.33	11.94	90.67
2x5	78.50	113.67	41.35	3.55	7.43	1121.33	10.52	20.67	18.04	124.47
2x6	73.00	114.50	46.81	2.67	5.13	775.67	11.18	19.50	18.18	106.51
2x7	68.33	109.33	45.35	3.42	6.88	323.00	10.17	10.67	19.30	603.34
3x4	65.83	105.50	40.62	3.45	5.57	558.67	9.65	15.17	18.67	125.35
3x5	NA	107.67	47.18	2.73	5.60	238.47	9.50	18.83	14.06	80.15
3x6	75.18	115.17	45.23	2.28	4.00	709.33	10.49	16.33	17.80	145.72
3x7	76.00	112.83	40.73	3.00	5.07	758.87	10.12	20.33	18.53	96.50
4x5	72.25	111.37	42.73	1.45	3.23	352.47	8.74	18.33	18.12	138.65
4x6	70.17	110.63	52.72	3.50	6.07	897.33	10.28	15.00	17.39	167.70
4x7	63.67	102.33	43.27	2.85	6.57	687.80	9.87	19.17	17.52	94.88
5x6	63.00	102.67	40.10	3.15	6.73	629.47	9.38	15.17	19.23	142.68
5x7	65.33	106.50	50.03	3.60	6.90	661.80	9.83	14.33	16.58	157.61
6x7	62.00	103.83	44.30	3.42	5.62	451.53	10.28	18.33	17.33	95.47
Mean	71.25	110.55	47.17	2.79	5.48	664.53	9.95	16.98	17.59	146.23
F-	16.53	—	—	—	—	—	—	10.84	6.11	280.22
LSD(0.05)										

*, ** = Significant at 5% and 1% level of probability respectively NA = Data not available

DTF=Days to flowering; DTM=Days to maturity; PHT=Plant height; NOB=number of branches;

NPPP=Number of panicles per plant; SY=Seed yield; SWt100= 100-seed weight;

E%=Emergence Percentage; EI= Emergence Index; ERI= Emergence Rate Index.

TABLE 2: Correlation Coefficient among E%, EI, ERI, Seed yield and other agronomic traits in parents of seven castor bean plant accessions (Makurdi and Yandev Combined, 2009)

Trait	DTF	DTM	PHt	NOB	NPPP	SY	Swt100	E%	EI	ERI
DTF	-	0.834**	0.354*	-0.529**	-0.294	-0.691**	-0.285	0.021	0.015	-0.047
DTM		-	0.388*	-0.642**	-0.369*	-0.722*	-0.2205	0.109	0.014	-0.177
NNPP			0.633**	-0.615**	-0.350*	-0.625**	-0.199	0.134**	-0.323*	-0.467*
NNSP			0.142	0.060	0.077	-0.066	0.248	0.097	-0.075	-0.191
PHt			-	0.137	0.194	-0.186	0.104	0.292	-0.478**	-0.450**
NOB				-	0.603**	0.607**	0.418**	-0.199	0.195	0.340**
NPPP					-	0.652**	0.306	-0.005	0.079	0.071
SY						-	0.432	0.104	0.167	0.042
SWT100							-	0.121	0.143	-0.145
E%								-	-0.016	-0.0800**
EI									-	0.469**
ERI										-

*, ** = Significant at 5% and 1% level of probability respectively;

DTF=Day to flowering; DMT=Days of maturity; PHt=plant height; NOB=number of branches; NPPP=Number of panicles per plant; SY=Seed yield; SWt100=100-seedweight; E%=Emergence percentage; EI=Emergency Index; ERI=Emergency Rate Index.

Table 3: Correlation Coefficients among E%, EI, ERI, Seed Yield and Other Agronomic Trait in 21 Hybrids of Seven Castor Bean plant Accessions (Makurdi and Yandev, 2009)

Trait	DTF	DTM	PHt	NOB	NPPP	SY	Swt100	E%	EI	ERI
DTF	-	0.908**	0.352**	-0.597**	-0.532**	-0.511**	-0.291**	0.014	-0.222*	-0.086
DTM		-	0.371**	-0.597**	-0.479**	-0.448**	-0.256**	0.050	-0.196*	-0.046
NNPP			0.644**	-0.496**	-0.362**	-0.447**	-0.245**	0.160	-0.350**	-0.159
NNSP			0.301**	0.214*	0.159	0.029	0.110	0.086	0.040	-0.117
PHt			-	-0.090	-0.019	-0.277	-0.070	0.129	-0.135	-0.086
NOB				-	0.722**	0.576**	0.498**	-0.280**	0.358**	0.154
NPPP					-	0.696**	0.295**	-0.150	0.200**	0.125
SY						-	0.382**	-0.182*	0.203**	0.028
SWT100							-	-0.213*	0.182	0.104
E%								-	-0.325**	-0.616**
EI									-	0.510**
ERI										-

*, ** = Significant at 5% and 1% level of probability respectively;

DTF=Day to flowering; DMT=Days of maturity; PHt=plant height; NOB=number of branches; NPPP=Number of panicles per plant; SY=Seed yield; SWt100=100-seedweight; E%=Emergence percentage; EI=Emergency Index; ERI=Emergency Rate Index.

Table 4: Correlation Coefficients among E%, EI, ERI, Seed Yield and other Agronomic Traits of Seven Castor Bean Plant Accessions and Their Hybrids Combined (Makurdi and Yandev, 2009)

Trait	DTF	DTM	PHt	NOB	NPPP	SY	Swt100	E%	EI	ERI
DTF	-	0.886**	0.345**	-0.577**	-0.472**	-0.540**	-0.278**	0.024	-0.164*	-0.087
DTM		-	0.369**	-0.603**	-0.452**	-0.493**	-0.231**	0.068	-0.148	-0.062
NNPP			0.640**	-0.520**	-0.357**	-0.471**	-0.229**	0.200**	-0.341**	-0.177*
NNSP			0.254**	0.175*	0.136*	0.007	0.160*	0.091	0.013	-0.199
PHt			-	-0.098	0.010	-0.251**	-0.017	0.161*	-0.208**	-0.110
NOB				-	0.701**	0.580**	0.460**	-0.267**	0.332**	0.168*
NPPP					-	0.688**	0.285**	-0.127	0.179*	0.122
SY						-	0.369**	-0.144	0.199**	0.037
SWT100							-	-0.144	0.161*	0.058
E%								-	-0.277*	-0.619**
EI									-	0.490**
ERI										-

*, ** = Significant at 5% and 1% level of probability respectively;

DTF=Day to flowering; DMT=Days of maturity; PHt=plant height; NOB=number of branches; NPPP=Number of panicles per plant; SY=Seed yield; SWt100=100-seedweight; E%=Emergence percentage; EI=Emergency Index; ERI=Emergency Rate Index.

There were however, inconsistent patterns of correlation among certain traits among the different sets of materials (parents only, hybrids only or a combination of the two) used in determining the degree of association. For instance, non-significant positive correlation in parents but significantly positive in hybrids and when the materials were combined was recorded for a number of branches with emergence index; number of panicles per plant with 100-seed weight; and seed yield per hectare with 100-seed weight. This indicated confounding effect and hence separate materials should be used in studying the degree of association among such traits. The weight of one hundred seeds depends on seed size (Uguru, 2000). Hence the positive correlation in emergence index and emergence rate index with 100-seed weight indicated that both EI and ERI influence 100-seed weight or seed size. These results agreed with that reported by Fakorede and Agbana (1983); and Opeke and Fakorede (1986) that there was positive correlation in emergence index and emergence rate index with 100-seed weight. The result, however, disagreed with the findings of Adeyemo and Fakorede (1995) who reported positive significant correlation of E% with grain yield and negative significant correlation of EI and ERI with yield in maize.

A vis-à-vis comparison of correlation among traits in parents and hybrids shows that some seedling vigour traits had no positive association with mature plant traits in parents (Table 3) but significant association for same traits in hybrids. This means that a genetic improvement on seedling vigour traits in castor would translate to an improvement in mature plant traits.

CONCLUSION

The study revealed that seedling vigour had varied degree of correlation with mature plant traits. Hence a genetic improvement on seedling vigour through

hybridization, would translate to an improvement in mature plant traits. There had been consistent and inconsistent patterns of correlation among traits depending on the type of material used. Hence the need in separating the materials in order to study the correlation among those traits that had confounding effects.

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