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CHARACTER ASSOCIATION ANALYSIS FOR OIL YIELD AND YIELD COMPONENTS IN BC_4F_1 POPULATION OF INTERSPECIFIC CROSS (*Jatropha curcas* x *Jatropha integerrima*)

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SUMMARY

Jatropha curcas has received considerable attention from researchers as a potential source of non-edible vegetable oil which is eminently suitable for production of liquid biofuel, meeting international standards. A field experiment was conducted during September 2010 at Tamil Nadu Agricultural University, Coimbatore to evaluate the correlation of yield and yield related characters. Correlation analysis revealed that for improving the seed yield per plant and oil yield per plant, selection has to be exercised on plant height, collar diameter, canopy cover in rows, canopy cover between rows, canopy volume, number of branches per plant, number of bunches per branch, number of fruits per bunch, number of seeds per fruit, fruit length, fruit width, seed length, capsule weight per plant, hundred seed weight, shelling per cent and oil content. The positive inter correlation among the yield components also indicated the possibility of simultaneous improvement of these characters.

Key words: Jatropha, backcross population, interspecific cross, oil yield, correlation, vegetative traits, reproductive traits

Key findings: The trait number of branches per plant contributed to higher number of bunches per branch which in turn contributed to higher number of fruits per bunch which finally culminated in higher yield. Selection of the trait hundred seed weight may help in indirect selection of high oil yielding genotypes.

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INTRODUCTION

Jatropha curcas L. (tropical physic nut) is a perennial multipurpose shrub or tree belonging to the family Euphorbiaceae. The species is adaptable to a wide range of soils and climate (0 to 500 m above sea level; mean annual temperature ranging from 20 to 28 ^{o}C with mean annual rainfall between 100 to 2000 mm or more) and grows well without any special nutrition regime. It can grow well under any unfavorable agro climatic conditions, because of its low moisture demands, fertility requirements and tolerance to high temperatures. *J. curcas* has medicinal values and is commonly grown as hedges to protect gardens and fields from animals (Openshaw, 2000). *Jatropha curcas* in tamil known as Kattamanakku and its oil can be used as bio diesel which blended up to 20 percent. The seed contains 46 to 58% of oil on kernel weight and 30 to 40% on seed weight (Subramanian *et al*., 2005). The oil is a rich

source of hydrocarbon (27 to 48.5% of seed oil) and hence, it is a potential as a biofuel crop. In India, 20% blend is targeted for 2020.

MATERIALS AND METHODS

The materials for this study consists of 94 genotypes along with check variety TNMC 7 were raised at Agricultural College and Research Institute, Coimbatore in 2010. The trial was laid out in a Randomized Block Design with 3 replications. Each genotype was planted with a spacing of 3 m x 2 m. Recommended management practices (FYM 2-3kg/pit, 20:120:16 g of NPK (Nitrogen, Phosphorous and Potassium)/pit/year and cultural practices (2-3 manual weeding per year, irrigation during dry period) were undertaken. Observations were recorded for 28 characters viz., plant height, collar diameter, leaf length, leaf width, leaf length width ratio, canopy cover in rows, canopy cover between rows, canopy volume, number of branches per plant, days to flowering, number of male flower per inflorescence, number of female flower per inflorescence, male to female flowers ratio, number of bunches per branch, number of fruits per bunch, number of seeds per fruit, fruit length, fruit width, fruit aspect ratio, seed length, seed width, seed aspect ratio, capsule weight per plant, hundred seed weight, shelling percent, oil content, seed yield per plant and oil yield per plant. The coefficients of simple correlation between various characters were estimated for the BC_4F_1 generation.

RESULTS AND DISCUSSION

The complex nature of seed yield is largely influenced by number of component traits. Hence information on the strength and direction of association of these component characters with oil yield and also inter association among them would be very useful in formulating an effective and viable breeding program for improvement of seed yield. Selection would therefore be more effective, if it is based on component characters rather than directly on yield. Correlation analysis measures the mutual relationship between various characters.

Simple correlation between oil yield and its component characters was studied and presented in Table 1. The study reveals that the traits *viz.*, plant height, collar diameter, canopy cover in rows, canopy cover between rows, canopy volume, number of branches per plant, number of bunches per branch, number of fruits per bunch, number of seeds per fruit, fruit length, fruit width, seed length, capsule weight per plant, hundred seed weight, shelling per cent, oil content and seed yield per plant had positive significant correlation with oil yield per plant as in the study of Prasanthi *et al.* (2009).

Among the vegetative characters studied the trait plant height exhibits significant positive inter correlation with collar diameter, leaf length, leaf width, canopy cover in rows, canopy cover between rows, canopy volume, number of branches per plant, number of bunches per branch, number of fruits per bunch, number of seeds per fruit, capsule weight, shelling per cent and seed yield per plant. Dhillon *et al.* (2003) and Ramachandran (2010) reported that plant height had significant positive correlation with collar diameter. The plant height was found to be positively correlated to yield character as reported by Rao (2009). The character collar diameter recorded significant positive correlation with number of branches per plant, capsule weight per plant and seed yield per plant. These results were in consistent with Ginwal *et al.* (2004) and Reeja (2007). Leaf length shows significant positive correlation with hundred seed weight as reported by Ramachandran (2010). Canopy volume exhibits significant association with number of branches per plant, number of bunches per branch, seed width, capsule weight and seed yield per plant. Similar results were reported by Ramachandran (2010). The trait number of branches per plant was found to be positively significant correlation with number of bunches per branch, number of fruits per bunch, number of seeds per fruit, seed length, seed aspect ratio, capsule weight per plant and seed yield per plant. Rao (2009) and Parthiban *et al.* (2011) reported number of branches per plant was significantly correlated with seed yield per plant.

Table 1. Simple correlation studies between oil yield and yield components.

Traits	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15	X16	X17	X18	X19	X20	X21	X22	X23	X24	X25	X26	X27
X2	0.54*																										
X3	0.16*	0.04																									
X4	0.21*	0.19*	0.72*																								
X5	-0.05	-0.19	0.40*	-0.34*																							
X6	0.61*	0.54*	0.10	0.13*	-0.03																						
X7	0.54*	0.49*	0.03	0.13*	-0.12*	0.74*																					
X8	0.71*	0.57*	0.08	0.14*	-0.07	0.86*	0.84*																				
X9	0.49*	0.57*	0.02	0.18*	-0.21*	0.69*	0.68*	0.74*																			
X10	0.07	-0.01	0.00	0.04	-0.06	-0.02	-0.05	-0.04	-0.01																		
X11	-0.12*	-0.12*	-0.03	-0.10	0.09	0.02	-0.01	-0.03	-0.06	0.06																	
X12	-0.07	-0.02	-0.03	-0.08	0.07	0.05	-0.02	-0.01	-0.01	0.10	0.73*																
X13	0.01	-0.08	0.02	0.03	0.00	0.00	0.04	0.02	-0.05	-0.07	0.13*	-0.54*															
X14	0.18*	0.22*	0.09	0.01	0.12*	0.27*	0.29*	0.34*	0.31*	-0.06	-0.08	-0.05	-0.01														
X15	0.29*	0.14*	0.00	0.01	-0.01	0.28*	0.24*	0.29*	0.30*	-0.09	-0.10	-0.02	-0.06	0.35*													
X16	0.21*	0.06	0.08	0.01	0.09	0.17*	0.17*	0.19*	0.12*	0.06	-0.01	0.05	-0.04	0.18*	0.33*												
X17	0.11	0.14*	0.03	0.01	0.03	0.15*	0.12*	0.18*	0.17*	-0.04	-0.04	-0.02	0.00	0.16*	0.09	0.21*											
X18	0.12*	0.14*	0.01	0.00	0.00	0.12*	0.17*	0.17*	0.16*	-0.04	-0.01	0.00	0.03	0.14*	0.09	0.21*	0.52*										
X19	0.00	-0.01	0.04	0.02	0.03	0.01	-0.05	0.01	0.01	-0.01	-0.02	-0.01	-0.02	0.02	0.02	0.02	0.51*	-0.46*									
X20	0.05	0.16*	-0.03	0.02	-0.07	0.12*	0.13*	0.14*	0.16*	0.03	-0.10	-0.04	-0.08	0.21*	0.07	0.03	0.50*	0.51*	0.00								
X21	-0.07	-0.01	0.00	-0.07	0.08	-0.02	0.11	0.00	0.04	-0.01	-0.05	-0.08	0.06	0.15*	0.04	0.07	0.26*	0.45*	-0.16*	0.39*							
X22	0.10	0.13*	-0.03	0.07	-0.14*	0.10	0.00	0.09	0.09	0.01	-0.04	0.05	-0.13*	0.01	0.02	-0.07	0.16*	-0.03	0.18*	0.45*	-0.61*						
X23	0.36*	0.39*	0.00	0.00	0.00	0.49*	0.47*	0.51*	0.51*	-0.02	-0.05	-0.04	-0.01	0.36*	0.33*	0.18*	0.26*	0.29*	-0.03	0.28*	0.15*	0.07					
X24	-0.02	0.07	0.13*	0.11	0.04	0.00	0.03	-0.01	0.06	0.03	-0.04	0.01	-0.08	0.01	-0.10	-0.09	0.11	0.07	0.05	0.15*	0.14*	0.03	0.15*				
X25	0.13*	0.05	0.12*	0.03	0.12*	0.07	0.04	0.04	0.05	0.10	0.03	0.04	-0.01	0.02	0.05	0.08	0.07	0.06	0.02	0.05	-0.01	0.05	0.15*	0.21*			
X26	-0.09	0.10	0.00	-0.01	-0.01	-0.07	-0.04	-0.09	0.02	-0.07	-0.04	-0.02	-0.08	-0.04	0.01	0.01	0.16*	0.14*	0.03	0.13*	0.15*	0.02	0.17*	0.28*	0.06		
X27	0.36*	0.35*	0.02	0.00	0.03	0.46*	0.45*	0.48*	0.48*	0.00	-0.03	-0.03	0.01	0.35*	0.32*	0.20*	0.25*	0.29*	-0.03	0.27*	0.13*	0.08	0.96*	0.19*	0.34*	0.18*	
X28	0.31*	0.35*	0.02	-0.01	0.03	0.42*	0.41*	0.44*	0.45*	-0.02	-0.03	-0.03	0.00	0.32*	0.30*	0.19*	0.26*	0.28*	-0.02	0.27*	0.14*	0.06	0.93*	0.23*	0.33*	0.35*	0.97*

*Significant at 5% level

X1 - plant height (cm); X2 - collar diameter (cm); X3 - leaf length (cm); X4 - leaf width (cm); X5 - leaf length width ratio; X6 - canopy cover in rows (m); X7 - canopy cover between rows (m); X8 - canopy volume (m3); X9 - number of branches per plant; X10 - days to first flowering; X11 - number of male flowers per inflorescence; X12 - number of female flowers per inflorescence; X13 - male female flower ratio; X14 - number of bunches per plant; X15 - number of fruits per bunch; X16 - number of seeds per fruit; X17 - fruit length (cm); X18 - fruit width (cm); X19 - fruit length width ratio; X20 - seed length (cm); X21 - seed width (cm); X22 - seed aspect ratio; X23 - capsule weight per plant (g); X24 - hundred seed weight (g); X25 - shelling percent; X26 - oil content; X27 - seed yield per plant (g); X28 - oil yield per plant (g).

Among the reproductive characters studied, the trait number of bunches per branch, number of fruits per bunch, number of seeds per fruit showed significant association with capsule weight per plant and seed yield per plant. Ramachandran (2010) observed significant correlation with capsule weight per plant and seed yield per plant. Das *et al*. (2010) also noticed that fruits per plant and bunches per plant had high positive correlation with seed yield per plant. Significant positive correlation was found between fruit length and fruit width, fruit length and fruit aspect ratio, fruit length and seed length, fruit width and seed length, fruit width and seed width. Shabanimofrad *et al*. (2011) also reported highly significant positive correlations between fruit length and fruit width, fruit length and seed length, fruit width and seed length, fruit width and seed width and seed length and seed width. The traits plant height, collar diameter, canopy volume, number of bunches per branch, number of fruits per bunch and capsule weight per plant had significant positive correlation with seed yield per plant. Similar results were observed by Ramachandran (2011).Seed yield per plant was also positively correlated with shelling per cent. Gururajarao *et al*. (2009) observed shelling per cent had positive association with seed yield, implying the effectiveness of simultaneous improvement of seed yield and shelling per cent. Hundred seed weight registered significant positive association with oil content. Ranwah *et al*. (2009) also found significant positive correlation with hundred seed weight. The significant positive association of oil content (%) with 100-seed weight suggested the effectiveness of indirect selection for seed oil content through 100-seed weight. The estimation of hundred seed weight being less expensive and laborious compared to seed oil content, Selection of the trait hundred seed weight may help in indirect selection of high oil yielding genotypes.

CONCLUSION

The correlations can be explained by the fact that during the phenological succession of appearance of physiological and morphological determinants of yield; canopy volume and the number of branches contributed to higher number of bunches per branch which in turn contributed to higher number of fruits per bunch which finally culminated in higher yield. Hence the trait number of branches may be used to the advantage of the breeder for bringing simultaneous improvement of Jatropha curcas. Significant association among canopy volume, number of branches per plant, and number of bunches per branch indicate that plants with good branching habit tend to develop more number of bunches. Hence, it is logical to conclude that for improving the oil yield per plant in Jatropha, selection has to be exercised on canopy volume, number of branches per plant, number of bunches per branch, number of fruits per plant, capsule weight per plant, hundred seed weight, oil content and seed yield per plant.

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