J. Indian Soc. Coastal Agric. Res. 35(2): 35-41 (2017)

Performance of Drought Tolerant African Dura Oil Palm under Coastal Region of Maharashtra

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Received: 17.08.2017 Accepted: 05.11.2017

Oil palm (*Elaeis guineensis*, Jacq.) is a potential crop to meet the vegetable oil requirement in India due to its higher productivity and better net returns to the farmers than any other edible oil yielding crop. Eighteen drought tolerant African Dura genotypes were evaluated under irrigated and rainfed conditions at Agricultural Research Station, Mulde on lateritic sandy loam soils of Konkan region in Maharashtra. Under rainfed condition genotype ZS-6 produced the maximum yield of 9.1 t ha^{-1} which was on par with ZS-8 (9.0 t ha^{-1}), ZS-5 (8.6 t ha^{-1}), TS-7 (8.3 t ha^{-1}), ZS-3 (7.7 t ha^{-1}), TS-10 (7.7 t ha^{-1}) and TS-9 (7.2 t ha^{-1}). Genotypes ZS-6 and TS-7 recorded higher yield under rainfed condition than irrigated condition with higher drought index of 115.2 and 109.2 per cent respectively. Zambian and Tanzanian genotypes were found superior in respect of yield and yield attributing characters as compared to Guinea Bissau genotypes. Under irrigated condition, genotypes ZS-8 and TS-10 recorded significantly higher fresh fruit bunch (FFB) yield (10.6 t ha^{-1}) followed by 9.7 t ha^{-1} in TS-2 and 9.6 t ha^{-1} in ZS-2 and ZS-5. Biochemical and physiological parameters among genotypes varied significantly. Under rainfed condition, genotype TS-8 recorded more relative water content (81.7%), and electrolyte leaching per cent was minimum in genotype TS-2 (41.7%). Lipid peroxidase values were lower in genotype TS-2 (0.092) and maximum epicuticular wax content was observed in genotype G.B. 25/314 (49.6 μg cm^{-2}).

***(Key words:** African dura oil palm, Biochemical and physiological parameters, Drought index, Genotypes, Yield)*

Oil palm (*Elaeis guineensis* Jacq.*)* is an important crop having high productivity and has the potential to meet the vegetable oil requirement in India and provide better net returns to the farmers than any other edible oil yielding crop. In India, oil palm is promoted as an irrigated plantation. Its cultivation is confined to areas where rainfall received is less than 2000 mm. It is estimated that around 150 mm water per month is required by oil palm to meet evapotranspiration demands (Narsimha Rao *et al.,* 2015). Rajagopal *et al.* (2005) suggested drought as first constraint for production in palms where most of cultivable areas are under water-limited conditions. The oil palm types performing well under limited water availability are meritorious under Indian conditions. Expanding the crop area under irrigation has several limitations, hence the approach has to be to identify the superior genotypes which can withstand moisture stress conditions in the field. Hence, potentially high yielding drought tolerant *dura* progenies could play a key role in evolving tenera hybrids for extending area under oil palm. Considering the irrigation potential in Maharashtra state, there is a great scope for area expansion under this crop. Nevertheless, the crop is prone to exposure to moisture stress during the month of April-May due to inadequate irrigation water and load shedding, etc. Hence, the present investigation was under taken to study the performance of drought tolerant African *dura* oil palm genotypes for identifying superior types suitable for Konkan region.

MATERIALS AND METHODS

The experiment was initiated under All India Coordinated Research Project on Palms at Agricultural Research Station, Mulde during 1999 in randomized block design with three replications and six palms per treatment. Eighteen drought tolerant genotypes of African *dura* oil palm which included three Guinea Bissau *viz*., G.B.25/314, G.B. 22/311, G.B. 21/310; eight Tanzanian *viz*., TS-2, TS-4, TS-5, TS-7 (Control), TS-8, TS-9, TS-10, TS-11 and seven Zambian *viz*., ZS-1, ZS-2, ZS-3, ZS-5, ZS- 6, ZS-9, ZS-8 were grown under rainfed conditions. These palms were used as experimental material for present investigation after bifurcating rainfed palms into two sets as three palms under irrigated and three palms under rainfed conditions during 2009 and irrigation treatment was imposed from October, 2009. The experimental station is located at 16° 2′ N

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latitude, 73° 42′ E longitudes and 17 m elevation above mean sea level in Konkan region of Maharashtra, which is a coastal part with an annual rainfall of 3000 mm received during June to September. The minimum temperature ranges from 12° to 24°C and maximum temperature from 26° to 38°C with average 80 per cent relative humidity. The soils are lateritic sandy loam with a pH of 6.01, well drained with 10 to 14 per cent slope. At field capacity, the moisture content is 28 to 30 per cent and at permanent wilting point, it is 16 to 18 per cent. The infiltration rate of the soil is very high (4.5 cm h^{-1}). Fertilizers were applied to oil palm genotypes @1200:600:2700 g N, P_2O_5 and K_2O per palm per year in a single dose during the month of August and irrigation was started after cessation of monsoon rain from October 2009. Observations on height, number of dried and drooped leaves, bunch failure, number of bunches produced, bunch weight and total yield were recorded. Biochemical and physiological parameters like relative water content (RWC), electrolyte leaching, peroxidase activity and epicuticular wax content were estimated in the month of May 2014 (stress period) by following the procedures described by Reddi *et al.* (2014). Data was statistically analyzed by following the method described by Gomez and Gomez (1986). Drought index was calculated by using the formula given by Chetti *et al.* (2002).

$$\text{Drought index (DI) \%} = \frac{\text{Yield under stress}}{\text{Yield under non stress}} \times 100$$

RESULTS AND DISCUSSION

Growth parameters

Data on palm height and leaf characters are presented in Table 1. It is revealed from the data that there was significant difference among the genotypes in respect of plant height, number of dried leaves, number of drooped leaves, bunch failure and fruit weight. Height of the palms was more in genotype G.B.25/314 both under irrigated (8.7 m) and rainfed (8.4 m) conditions. Lowest height under irrigated condition (3.6 m) was recorded in genotype ZS-9, whereas, under rainfed condition lowest height was 3.9 m in genotype ZS-1. Among Zambian genotypes height ranged between 3.6 m to 5.3 m under irrigated condition while under rainfed it was between 3.9 to 5.8 m and found dwarf in nature compared to other genotypes. Tanzanian and Guinea

Table 1. *Growth and fruit weight of different drought tolerant genotypes recorded during 2014*

Genotypes	Height (m)		Number of dried leaves		Number of drooped leaves		Bunch failure (No.)		Fruit wt. (g)	
	Irrigated	Rainfed	Irrigated	Rainfed	Irrigated	Rainfed	Irrigated	Rainfed	Irrigated	Rainfed
G.B.25/314	8.7	8.3	5.1	5.1	0.8	1.5	1.3	2.0	2.1	1.8
G.B.22/311	5.5	5.0	2.8	4.5	1.2	1.4	1.2	2.0	3.0	1.8
G.B.21/310	6.2	6.6	3.0	5.0	1.4	1.7	1.1	1.9	4.1	2.1
ZS-1	3.9	3.9	2.4	3.5	0.9	1.5	0.3	0.7	10.7	8.6
ZS-2	4.8	4.3	2.7	3.7	1.5	1.7	0.0	0.3	8.8	11.8
ZS-3	4.8	4.3	4.2	5.8	0.2	0.8	0.3	0.7	13.6	8.2
ZS-5	5.0	4.3	2.9	3.7	0.5	1.1	0.2	0.7	8.3	11.6
ZS-6	4.3	4.1	3.0	2.8	0.2	0.7	0.3	0.6	9.6	13.9
ZS-9	3.6	4.0	4.1	4.5	0.8	1.5	0.0	0.5	13.7	5.1
TS-2	5.0	4.7	4.7	3.5	1.3	1.9	0.3	1.0	8.9	12.9
ZS-8	5.3	5.8	2.8	3.5	0.3	1.0	0.0	0.0	7.4	11.4
TS-4	6.2	5.1	2.6	2.4	0.5	1.3	1.0	2.0	10.6	9.2
TS-5	6.9	6.7	3.5	2.9	0.8	1.7	0.0	0.7	8.7	10.5
TS-7 (Control)	6.1	5.7	2.2	3.2	0.8	1.5	0.0	0.0	9.0	7.1
TS-8	6.7	5.7	3.0	3.9	0.3	2.0	0.0	0.3	10.3	6.4
TS-9	5.6	5.8	3.2	4.3	0.9	1.4	0.3	1.0	12.2	11.4
TS-10	5.1	5.4	3.3	4.2	0.0	0.7	0.0	0.0	7.1	7.9
TS-11	5.0	5.1	1.9	3.4	0.8	1.6	0.3	0.7	8.8	8.7
SEm±	0.50	0.52	0.8	0.7	0.3	0.3	0.2	0.3	0.01	0.2
CD at 5 %	1.4	1.5	2.3	2.1	0.8	0.8	0.6	0.9	0.03	0.5

Bissau types were taller ones. Number of dried leaves was less in TS-11 (1.9) under irrigation while 2.4 in TS-4 under rainfed condition. Whereas, G.B. 25/314 recorded maximum dried leaves (5.1) under both conditions. Drooped leaves were not noticed in TS-10 under irrigated conditions, while it was only 0.7 under rainfed condition. Regarding bunch failure, genotypes ZS-8, TS-7 and TS-10 did not show any bunch failure, whereas it was noticed in all Guinea Bissau genotypes under both conditions. All Guinea Bissau genotypes were found more susceptible to water stress followed by Zambian and Tanzanian genotypes. Guinea Bissau recorded 4.1 g fruit weight under irrigated, while under rainfed it was only 2.1 g. Genotype ZS-9 recorded 13.7 g fruit weight under irrigation while ZS-6 recorded 13.9 g fruit weight under rainfed condition. Similar results were recorded by Reddi *et al.* (2014).

Biochemical and physiological parameters

The relative water content (RWC) percent magnitudes were more in most of the genotype under irrigated condition as compared to rainfed condition (Table 2). RWC values were significant under rainfed conditions and were in a range of 71.1 percent (G.B. 25/314) to 81.7 percent (TS-8). Genotype TS-7 (80.4%) and ZS-3 (80.3%) were on par with the genotype TS-8. While under irrigated condition it ranged from 76.2 percent (G.B.21/310) to 91.9 per cent (ZS-8). Data also revealed that there was significant difference among various genotypes for electrolyte leaching under both conditions. Under irrigated condition percentage of leachate varied from 42.0 percent (G.B. 25/314) to 53.7 percent (ZS-9). While under rainfed condition it varied from 41.7 percent (TS-2) to 50.5 percent (ZS-1). Reddi *et al.* (2014) reported higher RWC in Zambian genotypes. Significant effect on peroxides activity among different genotypes was also recorded under both situations; however, genotypes under rainfed condition exhibited lower absorption values (ABS values) compared to irrigated condition indicating drought susceptibility. Genotype G.B. 25/314 exhibited more ABS values under both conditions while ZS-5 and ZS-9 recorded the lowest values (0.077) under irrigated and rainfed conditions, respectively. In the present study there was significant difference among the genotypes for wax content in leaf

Table 2. *Response of different genotypes for biochemical attributes recorded during 2014*

Genotypes	RWC %		Electrolyte Leaching (%)		Lipid Peroxidase (ABS value)		Epicuticular Wax μ g cm^{-2}	
	Irrigated	Rainfed	Irrigated	Rainfed	Irrigated	Rainfed	Irrigated	Rainfed
G.B.25/314	86.4	71.1	42.0	42.9	0.369	0.309	17.7	49.6
G.B.22/311	79.7	77.8	43.6	44.6	0.280	0.182	9.2	19.1
G.B.21/310	76.2	76.6	43.8	42.3	0.189	0.183	7.4	21.6
ZS-1	82.8	73.4	45.7	50.5	0.125	0.154	9.4	13.7
ZS-2	78.9	73.0	53.2	45.7	0.246	0.185	8.2	9.8
ZS-3	85.4	80.3	46.5	45.3	0.162	0.119	7.0	12.0
ZS-5	85.3	74.5	50.5	47.0	0.077	0.150	9.9	14.7
ZS-6	85.6	77.2	52.4	44.8	0.124	0.138	3.5	13.1
ZS-9	84.0	72.4	53.7	45.5	0.169	0.077	28.7	13.5
TS-2	83.1	75.4	49.9	41.7	0.141	0.092	1.0	18.7
ZS-8	91.9	70.8	49.7	43.4	0.135	0.167	7.5	10.4
TS-4	82.0	74.1	49.1	47.9	0.227	0.240	23.3	12.4
TS-5	83.2	77.4	44.7	44.2	0.192	0.165	38.4	12.0
TS-7 (Control)	77.5	80.4	45.7	46.9	0.139	0.140	1.3	14.3
TS-8	79.6	81.7	50.9	48.9	0.218	0.180	12.4	17.6
TS-9	82.8	77.6	44.2	42.1	0.132	0.226	42.1	27.2
TS-10	78.4	72.9	47.6	46.2	0.068	0.172	25.3	7.6
TS-11	82.9	79.4	50.3	48.3	0.092	0.178	41.0	4.2
SEm±	2.9	2.2	2.0	1.5	0.002	0.003	1.4	0.2
CD at 5 %	N.S.	6.3	5.7	4.3	0.006	0.010	4.0	0.4

tissue under irrigated, as well as rainfed conditions. Under irrigated condition, wax content values ranged from 1.3 μ g cm^{-2} (TS-7) to 42.1 μ g cm^{-2} (TS-9) whereas under rainfed condition the values ranged from 4.2 μ g cm^{-2} (TS-11) to 49.6 (G.B.25/314). Rajagopal *et al.* (2005) suggested that when prolonged water deficits prevails, there is an increases in epidermal waxes of leaves which reduce the cuticular transpiration, hence estimation of epicuticular wax content could be useful method to screen the varieties for drought tolerance in palms.

Yield and yield attributing parameters

During the year 2012 and 2014 number of bunches produced by different genotypes was significant under rainfed conditions (Table 3). During the year 2012 under rainfed conditions ZS-6 produced 8 bunches per palm, whereas, G.B. 21/310 produced only 2.5 bunches per palm. All Zambian genotypes were on par with ZS-6. Among the Tanzanian genotypes, TS-2 produced 7.8 bunches per palm which was at par with ZS-6. TS-2 also produced the highest number of bunch (9.1) under irrigated conditions. During the year 2013, under both the conditions number of bunches produced among different genotypes were statistically significant. Genotypes TS-2 recorded maximum bunches i.e. 9.1 per palm followed by ZS-3 (8.2) and TS-10 (7.8) under irrigated conditions whereas, under rainfed conditions ZS-1, ZS-2 and ZS-9 produced 6.8 bunches followed by TS-7 (6.7), ZS-3 and ZS-5 (6.3). However, all these genotypes were on par with each other. During the year 2014, genotypes significantly differed under rainfed conditions and genotype ZS-1 produced 6.2 bunches per palm followed by TS-2 (5.8). Pooled mean data regarding number of bunches over the years showed that under rainfed condition, genotype ZS-2 produced maximum bunches *i.e.,* 6.6 followed by TS-2 (6.3), ZS-1, ZS-6 and ZS-9 (6.2) and ZS-3 (6.1); however, all these genotypes were on par with ZS-2. Under irrigated condition, genotype TS-2 produced 8.0 bunches which was on par with TS-10 (7.1). All Zambian genotypes under the study produced bunches in a range of 6.0 to 6.4. Similar results were reported by Reddi *et al.* (2014) under rainfed condition where ZS-3 was reported as more

Table 3. *Number of bunches of different genotypes under rainfed and irrigated conditions*

Genotypes	Average number of fresh fruit bunch						Pooled	
	2012		2013		2014			
	Irrigated	Rainfed	Irrigated	Rainfed	Irrigated	Rainfed	Irrigated	Rainfed
G.B.25/314	3.8	3.3	2.5	1.8	2.4	1.5	2.9	2.2
G.B.22/311	4.6	3.8	5.3	4.0	3.1	2.7	4.3	3.5
G.B.21/310	4.0	2.5	2.4	2.1	4.0	3.0	3.5	2.5
ZS-1	7.0	5.7	7.0	6.8	4.5	6.2	6.1	6.2
ZS-2	8.3	7.6	6.3	6.8	4.7	5.4	6.4	6.6
ZS-3	5.6	7.9	8.2	6.3	4.7	4.2	6.2	6.1
ZS-5	6.7	6.5	7.0	6.3	4.4	3.4	6.0	5.4
ZS-6	7.2	8.0	6.7	5.1	4.0	5.5	6.0	6.2
ZS-9	7.8	7.1	7.6	6.8	3.8	4.6	6.4	6.2
TS-2	9.1	7.8	9.1	5.3	5.8	5.8	8.0	6.3
ZS-8	6.6	6.0	6.2	4.7	5.2	4.8	6.0	5.2
T-4	4.0	4.9	7.1	5.1	4.2	4.0	5.1	4.7
TS-5	4.9	4.3	4.8	4.5	4.5	3.6	4.7	4.1
TS-7 (Control)	4.0	3.8	5.5	6.7	4.9	5.6	4.8	5.4
TS-8	5.2	5.1	3.3	4.8	4.3	3.1	4.3	4.3
TS-9	7.5	5.3	6.3	4.4	3.7	4.0	5.8	4.6
TS-10	8.9	5.1	7.8	5.3	4.6	3.7	7.1	4.7
TS-11	5.0	4.6	5.7	4.9	3.9	4.4	4.9	4.6
SEm±	1.4	0.9	1.1	1.0	1.0	1.0	0.6	0.5
CD at 5 %	N.S.	2.7	3.3	2.9	N.S.	2.8	1.8	1.5

bunch producing genotype. However, low yield is reported in Guinea Bissau genotypes even with more number of bunches (Anonymous, 2014).

The weight of the bunch was significantly different among different genotypes during the period of study under both the environments (Table 4). During the year 2012, ZS-8 produced 12.0 kg bunch followed by ZS-5 and TS-10 (11.0 kg bunch). Under rainfed conditions, TS-7 produced 12.8 kg bunch which was on par with ZS-8 (12.4 kg). During the year 2013, under irrigation ZS-8 yielded 13.1 kg bunch followed by 11.3 kg in TS-5 whereas, under rainfed condition ZS-5 and ZS-8 recorded 12.3 kg bunch which was on par with TS-8 (12.2 kg). During 2014, TS-8 had highest bunch weight (16.5 kg) and was on par with other Tanzanian genotypes except TS-2, whereas, under irrigated conditions TS-9 recorded 13.6 kg bunch weight followed by 12.4 kg in TS-8. Data on pooled mean bunch weight over the years showed that under both conditions, ZS-8 recorded maximum bunch i.e. 12.7 and 12.1 kg followed by 11.7 kg and 11.5 kg in TS-8. It indicated that bunch weight was not affected by any environment in these genotypes. Among different genotypes, ZS-8 produced better bunch weight over the years under both the conditions. Gajbhiye *et al*. (2011) also recorded more bunch weight in ZS-8 under rainfed condition. Guinea Bissau genotypes recorded comparatively lower bunch weight during the period of the study.

Data on yield of fresh fruit bunches (FFB) presented in Table 5 revealed that there was significant difference among the genotypes under both the conditions. During 2012, genotype TS-10 recorded maximum yield (13.0 t ha^{-1}) of FFB, followed by 11.3 t ha^{-1} in ZS-2 under irrigated conditions. Whereas, under rainfed condition ZS-6 recorded 11.2 t ha^{-1} followed by 10.9 t ha^{-1} in ZS-8. During the year 2013 under irrigated condition, ZS-3 recorded maximum yield (12.7 t ha^{-1}) of FFB, followed by 11.3 t ha^{-1} in ZS-8. However, under rainfed condition ZS-5 recorded 10.7 t ha^{-1} yield followed by 9.7 t ha^{-1} in TS-7. In the year 2014, under irrigation, genotype TS-8 recorded 9.9 t ha^{-1} FFB yield followed by ZS-8 (9.4 t ha^{-1}), and both were on par. Whereas, under rainfed condition genotype ZS-6 recorded 9.3 t ha^{-1} FFB yield followed by

Table 4. *Bunch weight of different genotypes under rainfed and irrigated conditions*

Genotypes	Average bunch weight (kg)						Pooled mean weight (kg)	
	2012		2013		2014			
	Irrigated	Rainfed	Irrigated	Rainfed	Irrigated	Rainfed	Irrigated	Rainfed
G.B.25/314	3.8	4.1	2.7	3.1	5.4	3.6	4.0	3.6
G.B.22/311	5.5	5.3	7.0	5.9	7.5	6.2	6.7	5.8
G.B.21/310	5.2	4.9	6.0	5.5	7.4	5.9	6.2	5.4
ZS-1	9.6	9.0	10.6	8.3	12.1	7.8	10.8	8.4
ZS-2	9.6	8.7	10.3	7.6	11.9	11.2	10.6	9.2
ZS-3	9.9	8.5	11.0	8.5	12.0	9.7	11.0	8.9
ZS-5	11.0	10.9	9.5	12.3	12.6	11.3	11.0	11.5
ZS-6	9.2	10.0	9.6	9.4	10.9	11.8	9.9	10.4
ZS-9	5.9	6.7	7.2	7.3	6.5	8.4	6.5	7.5
TS-2	9.1	7.1	8.3	7.2	9.3	8.7	8.9	7.7
ZS-8	12.0	12.4	13.1	12.3	13.0	11.5	12.7	12.1
TS-4	8.5	9.5	9.8	9.3	11.3	10.3	9.9	9.7
TS-5	9.4	12.1	11.3	9.0	12.5	9.3	11.1	10.1
TS-7 (Control)	10.9	12.8	10.8	9.5	12.5	10.4	11.4	10.9
TS-8	9.4	10.0	9.1	12.2	16.5	12.4	11.7	11.5
TS-9	9.2	9.8	7.7	10.8	12.8	13.6	9.9	11.4
TS-10	11.0	11.0	10.0	11.7	12.1	11.1	11.0	11.3
TS-11	10.7	9.4	10.8	8.8	12.8	9.2	11.4	9.1
SEm±	1.1	1.4	1.2	1.5	1.6	1.3	0.6	0.6
CD at 5 %	3.2	4.0	3.4	4.3	4.5	3.7	1.8	1.7

Table 5. *Fresh fruit bunch (FFB) yield of different genotypes under rainfed and irrigated conditions*

Genotypes	Average yield of FFB (t ha^{-1})						Pooled mean (t ha^{-1})		Drought Index (%)
	2012		2013		2014				
	Irrigated	Rainfed	Irrigated	Rainfed	Irrigated	Rainfed	Irrigated	Rainfed	
G.B.25/314	1.9	2.0	1.6	1.2	2.3	1.2	1.9	1.4	73.7
G.B.22/311	3.6	3.0	5.3	3.4	3.3	2.5	4.1	3.0	73.2
G.B.21/310	2.5	1.7	1.9	1.6	4.2	2.5	2.9	1.9	65.5
ZS-1	9.6	7.1	11.0	7.9	7.9	7.0	9.5	7.3	76.8
ZS-2	11.3	8.8	9.5	7.4	8.0	8.9	9.6	8.4	87.5
ZS-3	8.0	9.6	12.7	7.6	7.7	5.8	9.5	7.7	81.0
ZS-5	10.2	9.8	9.7	10.7	8.9	5.3	9.6	8.6	89.6
ZS-6	9.4	11.2	8.9	6.8	5.5	9.3	7.9	9.1	115.2
ZS-9	6.5	6.2	7.9	6.7	4.0	5.1	6.1	6.0	98.4
TS-2	10.6	7.7	10.8	5.4	7.6	7.2	9.7	6.8	70.1
ZS-8	11.0	10.9	11.3	8.3	9.4	7.9	10.6	9.0	84.9
TS-4	5.0	6.5	9.7	6.8	6.6	6.0	7.1	6.4	90.1
TS-5	6.6	6.2	8.0	5.9	8.0	4.1	7.5	5.4	72.0
TS-7 (Control)	6.1	6.7	8.3	9.7	8.4	8.5	7.6	8.3	109.2
TS-8	6.9	7.5	4.3	7.3	9.9	5.5	7.0	6.8	97.1
TS-9	10.2	7.4	7.0	6.5	6.9	7.9	8.0	7.2	90.0
TS-10	13.0	8.3	11.1	8.5	7.8	6.3	10.6	7.7	72.6
TS-11	8.2	5.8	8.9	6.1	7.0	6.0	8.0	6.0	75.0
SEm±	1.7	1.4	1.9	1.4	1.6	1.6	1.0	0.7	
CD at 5 %	4.9	4.0	5.5	3.9	4.5	4.7	2.8	2.0	

8.9 t ha^{-1} in ZS-2. During the period under study, Zambian genotypes recorded higher yield under both conditions while Guinea Bissau recorded lower FFB yield. Data on pooled mean yield reveled that under rainfed condition, maximum yield of 9.1 t ha^{-1} was recorded in genotype ZS-6 which was on par with ZS-8 (9.0 t ha^{-1}) followed by ZS-5 (8.6 t ha^{-1}), ZS-2 (8.4 t ha^{-1}), TS-7 (8.3 t ha^{-1}), ZS-3 and TS-10 (7.7 t ha^{-1}). Under irrigated condition, the highest yield of 10.6 t ha^{-1} FFB was recorded in genotypes ZS-8 and TS-10 followed by 9.7 t ha^{-1} in TS-2 and 9.6 t ha^{-1} in ZS-2 and ZS-5 and all were found on par with each other. Our study also revealed that genotypes ZS-6 and TS-7 recorded higher yield under rainfed condition than in irrigated conditions, thereby these genotypes registered higher drought index of 115.2 and 109.2 per cent, respectively. Genotype ZS-8, TS-8 and TS-9 recorded drought index more than 90 per cent and suggest better performance under stress conditions. In the present study Zambian and Tanzanian genotypes were found superior in respect of yield and yield attributing characters, whereas, all Guinea Bissau genotypes were the lowest yielders. These findings confirms the earlier results of Anonymous (2014), Reddi *et al.* (2014), Gajbhiye *et al.* (2011) and Mathur *et al.* (2005) who evaluated African oil palm germplasm for water stress conditions.

Thus, the present investigation on the performance of different drought tolerant oil palm genotypes revealed that, among the eighteen genotypes tested under irrigated and rainfed conditions, ZS-6, TS-7, ZS-9, TS-8, TS-9 and ZS-5 were found to be a promising genotypes over others on the basis of high yield, drought index and tolerance to moisture stress based on physiological and biochemical traits. The study also suggests these genotypes for inclusion in further breeding programmes of *dura* oil palm improvement by developing different cross combinations.

ACKNOWLEDGEMENT

The authors are thankful to the ICAR, New Delhi for funding under All India Co-ordinated Research Project on Palms, Indian Institute of Oil Palm Research, Pedavegi (A.P.) for providing experimental material and Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli for providing facilities for this investigation.

REFERENCES

Anonymous, (2014). *Annual Report of Directorate of Oil Palm Research*, Pedavegi. A.P. pp 14**.**

Chetti, M. B., Kalpana, M. and Hiremah, S. M. (2002). *Principles of drought tolerant measurements. In: Physiological Approaches for Enhancing Productivity Potential Under Drought Condition,* M. B. Chetti, S. M. Hiremath and M. Kalpana (eds.), University of Agricultural Sciences, Dharwad. pp 55-66.

Gajbhiye, R. C., Gawankar, M. S., Arulraj, S. and Patil, S. L. (2011). Evaluation of drought tolerant oil palm genotypes for their performance in Konkan region of Maharashtra. *Journal of Plantation Crops* **39**(1): 161-163.

Gomez, K. A. and Gomez, A. A. (1986). *Statistical Procedures for Agriculture Research*, Second Edition, John Wiley and Sons, New York. 680 p.

Mathur, R. K., Murugesan, P. and Usha Vani, D. (2005). Evaluation of African oil palm (*Elaeis guineensis* Jacq.) germplasm for water stress conditions. Invited Papers and Abstracts National Seminar on *Research and Development of Oil Palm in India*. February 19-20, 2005, NRCOP, Pedavegi, Andhra Pradesh, India. 169 p.

Narsimha Rao, B., Suresh, K. and Behera, S. K. (2015). *Water management in oil palm.* Proceedings National Seminar on *Research and Development of Oil Palm cultivation in India through NMOOP*, February 5-6, 2015, NRCOP, Pedavegi, Andhra Pradesh, India. pp 7-9.

Rajagopal, V., Kasturi Bai, K. V. and Naresh Kumar, S. (2005). *Strategies for evolving drought tolerance in palm*. Invited Papers and Abstracts National Seminar on *Research and Development of Oil Palm in India*. February 19-20, 2005, NRCOP, Pedavegi, Andhra Pradesh, India. pp 16-20.

Reddi, S.G., Patil, D. R., Maheshwarappa, H. P., Arulraj, S., Mastana Reddy, B. G. and Chandravathi, B. (2014). Evaluation of African oil palm germplasm for drought tolerance. *Journal of Plantation Crops* **42**(2): 170-174.