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Comparative Study of Growth and Seed Yield of Jatropha Curcas Landrace Types of South West Nigeria

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Abstract:
Jatropha (Jatropha curcas L.) has been identified as an alternative source of biofuel in an increasing demand for energy but with declining fossil fuel resources. In Nigeria, many landrace types have not being evaluated for their productivity.
A field experiment was conducted to evaluate nine landrace types of J. curcas collected from deferent parts of Nigeria in the Teaching & Research farm of University of Ibadan, between September 2009 and March 2010, for the growth and yield parameters. Twenty stands of each landrace type were planted at spacing of 2m x 3m in a Randomized Complete Block Design (RCBD) in four replications.
The results showed that Ode, Ede and Egbe1 landrace types flowered at 18, 20, and 22, weeks after sowing (WAS) respectively but Dagbala and Egbe 2 starts flowering at 26 WAS while others only grew vegetatively. Ode produced the highest number of primary branches while the order of leaf biomas was Dalgbala > Ode > Ede > Egbe2 > Egbe1 > Ex-dala > Ex-Kwagiri > Wakajaye > Ex-mbat-daya respectively. At 30WAS the yield of Jatropha landrace types obtained were 3.98, 3.2, 0.5and 0.5g/24m^2 for Ode, Ede, Egbe1 and Dagbala respectively while other land races did not produce any yield. However, there was no significant difference observed in the means of the yield parameters observed for all the landrace types.
Ode, Ede, and Egbe1 had the best performance due to their early flowering and fruiting abilities.

Key words*: Jatropha curcas, comparative study, growth rate, seed, yield, landrace types*

1. Introduction

Jatropha Curcas L. belongs to the family Euphorbiaceae and the genus Jatropha. It is considered to have originated from Central America, most probably Mexico, where it is found extensively in different region of the country. Jatropha plants that occurred in various climate regions and sometimes from the same climate zone shows morphological differences particularly with regard to their shape, size of seeds, protein and lipid content. (Jorge et al., 2010.Jatropha Curcas is a deciduous shrub that grows up to a height of 3.5 meters and with a production life of 50 years. The genus Jatropha includes a large number of species (170) that are distributed over the world in habitats ranging from the tropical to the template zone. Jatropha is fast growing and produces seeds after approximately 1-3 years, depending on rainfall conditions and how the plant is propagated. Jatropha grows on well-drained soil with good aeration and is well adapted to marginal soil with low nutrient content. It occurs mainly at lower altitudes (0-500m) in areas with average annual temperatures well above 20^{o}C but can grow at higher altitudes and tolerates slight frost. Jatropha is a valuable multipurpose crop that alleviates soil degradation, desertification and deforestation which can be used for bio-energy to replace petro-diesel, soap production and climatic protection (CJP 2007). Jatropha is a small tree with smooth gray bark, which exudes whitish coloured watery latex cut and its stain is difficult to remove. Normally it grows between three and five meters in height, but can attain a height of up to eight or ten meters with diameter up to20cm under favorable conditions (Henning 2000). The trunk is straight, branching low above the ground, bark is thin and yellowish, leaves are 6 x 15cm and lobed. Flowers are small greenish, unisexual with male and female flowers on the shrub. The Petiole length of flower ranges between 6-23mm and the inflorescence is formed in the leaf axil (Heller 1996).

The individual flowers are grouped together in the racemose inflorescences, an arrangement which promotes attraction. The plant with a monoecious sexual system essential requires an agent for pollen transfer for male and female (CJP 2007).

Due to the increasing demand for energy and declining fossil fuel resources, alternative sources of energy are more and more in the center of attention (Becker et al., 2003). In Nigeria the use of J. curcas is not maximized because of the inadequate knowledge about the characters of different landrace types. This study is focused on evaluating different land race of Jatropha curcas for their different desirable traits to compare different Jatropha landrace types of south western Nigeria in respect of growth attributes and to select the best performing landrace of Jatropha under local condition

2. Research Methods

Nine Jatropha landrace types were collected from different parts of Nigeria as shown in table 3.1. The field experiment was carried out from September 2009 to March 2010 to compare the different types. The experiment was carried out at the Teaching and Research of the University of Ibadan, Ibadan, Oyo State. The site lies between Latitude N 07^0 27' 15.6" and Longitude E 003^0 53' 32.2" with Elevation 200m above sea level. The land was manually cleared, The total dimension of the experimental field was 15m x 64m, which was demarcated into plots of gross and not plot size of 6.5m x 12m and 6.5m x 12m, respectively.

Jatropha seeds of the different landrace types were sown on a flat land at spacings of 2m x 3m at 2 seeds per hole and a gap of 2m between plots were given. The experiment was laid out in a Randomized complete block design (RCBD) with three replications. At one week after sowing, the Jatropha landrace types were tagged for easy identifications, observation of germination dates, measurement of plant height, stem girth, number of leaf and number of branching, were taken at two weeks internal. At the onset of flowers initiations, data on flower and fruit counts were taken and recorded. The Jatropha fruit was then harvested weeks after planting when it attain a ripen stage or show a ripen appearance (i.e. colour change from green to yellow) or light yellow. Thus, harvested mature fruits produced were weighed; pod and seed per pant of the landrace types were equally measured. This was carried out at 4week after sowing, 2month and 6month after sowing, during the development periods hence, weeding was done continually due to persistence rainfall, The Jatropha fruit was harvested immediately they attained maturity by showing a ripen appearance (i.e. colour change from green to yellow) or light yellow, fruit were weighed out from all the different landrace. The performance of Jatropha was evaluated using growth and yield attributes such as plant height, number of leaves produce, stem girth, number of branching, number of flowers ,number of fruit and weight of fruit, seeds pod would also be monitored. The data were subjected to descriptive analysis and analysis of variance (ANOVA) using SAS analysis and means separated by Duncan Multiple Test (DMRT).

S/No	Landraces	location/sources
1	ODE	Ekiti
2	EGBE 1	Ekiti
3	EX-MBAT-DAYA	Bauchi
4	EX-DALA	Kano
5	EDE	Osun
6	WAKAJAYE	Oyo
7	EX-KWAGIRI	Kaduna
8	DAGBALA	Edo
9	EGBE 2	Ekiti

Table 1: Samples seeds of Jatropha landraces types and their place of collection

3. Results and Discussion

The deferent landrace types of the seed to be evaluated were sown on the 1st of September 2009, at 5 day after sowing the seeds being to germinate for some samples while the emergence occurred from the 6th day of sowing, for Ode, Ede Egbel, Egbe2, Dagbala, Ex-dala, Wakajaye types where as Ex-mbat-daya landrace emerge at 10th day follow by Ex-Kwagiri that emerged at the 11th day of sowing. At the emergence of the landrace types two leaves emerged at the initiation of plant growth.

3.1. Morphological Characteristic

Jatropha curcas of the different landrace types have similar leaf shape (irregular shape). The stem colour was ranged from whitish brown below the stem, deep green with white patches and light green at the upper parts of the stem.

The leaf colour was red at the initial growth stage before fully grown to matured leaf of green colour. The stalk colour shows a red appearance at the upper part and below the leaf, yellowish light green at the middle part while deep green or red colour at lower part of the stalk. The colour of the vein is yellowish green and green colour.

3.2. Plant height

Table 2. Shows the plant height of Jatropha landrace types.

Ex-mbat-daya consistently had significantly shorter plants than the tallest, Ode 10 and 20WAS while Dagbala at 30WAS. Furthermore Ex-kwagiri plants were also shorter than those of Ode at 10 and 20WAS while Wakajaye was shorter than Ode and Dagbala at 20 and 30WAS, respectively.

	Plant height (cm)		
Varieties/landrace	**10WAS**	**20WAS**	**30WAS**
Ode	36.78a	78.28a	96.40ab
Ege1	28.48ab	53.98ab	82.28ab
Ex-mbat-daya	9.95b	21.38b	35.15b
Ex-dala	21.70ab	42.70ab	64.88ab
Ede	27.10ab	61.40ab	95.20ab
Wakajaye	23.18ab	2785ab	43.05b
Ex-Kwagiri	16.70b	28.65b	50.83ab
Dagbala	36.63ab	70.10ab	109.93a
Egbe2	28.33ab	47.07ab	88.08ab

Table 2: Plant height of Jatropha landrace types
Different letters in the same column show that means are significantly different (p=0.05) according to Duncan's Multiple Rang Test

3.3. Stem girth

Table 3. Show the stem girth the of jatropha landrace types.

Ex-mbat-daya had significantly smaller stem girth throughout the maximum of 4.00cm at 10WAS for Egbe 2, 11.50cm at 20WAS for Ode and 12.75cm for Ode at 30WAS.

3.4. Number of leaf

Leaf number only differ significantly among landraces at 20WAS with Ode producing the highest number of 80.75 while Ex-mbat-daya and Ex-kwagiri had lower production of 15.00 and 12.75 respectively. (Table 4))

3.5. Number of primary branching

Ode consistently produced the highest number of branches while Egbe 1 and was comparable at 20WAS. Egbe1, Egbe 2 and Dagbala also produce branch comparable to that of the maximum Ode at 30WAS. (Table 5))

	Stem girth (cm)		
Varieties/landrace	**10WAS**	**20WAS**	**30WAS**
Ode	3.95a	11.50a	12.75a
Ege1	3.38a	10.50ab	11.85ab
Ex-mbat-daya	1.50b	4.80b	5.35b
Ex-dala	3.30a	8.35ab	9.83ab
Ede	3.65a	10.03ab	12.23a
Wakajaye	3.23a	6.58ab	7.35ab
Ex-Kwagiri	2.65ab	6.78ab	7.90ab
Dagbala	3.48a	10.25ab	12.30a
Egbe2	4.00a	8.20ab	10.58ab

Table 3: Stem girth of Jatropha landrace types
Different letters in the same column show that means are significantly different (p=0.05) according to Duncan's Multiple Rang Test

	Number of leaves (cm)		
Varieties/landrace	**10WAS**	**20WAS**	**30WAS**
Ode	27.75	80.75a	65.00
Ege1	29.00	64.00ab	67.75
Ex-mbat-daya	7.26	15.00b	42.50
Ex-dala	10.50	24.50ab	79.50
Ede	18.25	45.75b	106.00
Wakajaye	9.00	12.75b	52.75
Ex-Kwagiri	10.00	18.50b	50.00
Dagbala	28.25	46.25ab	157.75
Egbe2	17.75	41.75ab	139.75
	ns	ns	ns

Table 4: Number of leaves of Jatropha landrace types
Different letters in the same column show that means are significantly different (p=0.05) according to Duncan's Multiple Rang Test.

	No. primary branching (count)		
Varieties/landrace	**10WAS**	**20WAS**	**30WAS**
Ode	0.25	1.75a	2.25a
Ege1	0.50	1.00ab	1.75ab
Ex-mbat-daya	0.00	0.00c	0.00c
Ex-dala	0.00	0.00c	0.00c
Ede	0.00	0.25bc	0.50bc
Wakajaye	0.00	0.00c	0.00c
Ex-Kwagiri	0.00	0.00c	0.00c
Dagbala	0.25	0.50bc	0.75abc
Egbe2	0.00	0.25bc	0.75ab
		ns	

Table 5: Number of primary branching of Jatropha landrace types
Different letters in the same column show that means are significantly different (p=0.05) according to Duncan's Multiple Rang Test

3.6. Number of flowers produced

Flower initiation was first observed for Ode, Egbel and Ede landrace types. With regard to these, there were no significant differences in the number of flower throughout the weeks of sampling. Thus the highest number flower is indicated at Ode types at 18^{th} -22^{nd} week after sowing but was not different from Egbel and Ede types.

At 20^{th} -30^{th} weeks after sowing, Dagbala produced the highest flower mean of 70.00 but not significantly different from other types Table 6

3.7. Number of fruits produced

There were no significant different on the number of fruit produced for all the landrace types, Ode produced the highest number of fruit mean (3.25) from the inception of fruit but not significantly different from Ede and Egbe1, while at 30^{th} WAS Dagbala give the lightest compared to the other. Table.7

3.8. Number of fruit harvested

With regard to the number of fruit harvested, there were no significant differences in the number of fruit harvested throughout the sampling week, but Ode, Egbe1 and Ede give fruit at different sampling weeks, while other did not. Table 8

	Number of flower (cm)			
varieties/landrace	**18WAS**	**22WAS**	**26WAS**	**30WAS**
Ode	17.25	9.5	0.00	30.00
Ege1	10.00	5.00	14.00	0.00
Ex-mbat-daya	0.00	0.00	0.00	0.00
Ex-dala	0.00	0.00	0.00	0.00
Ede	7.50	6.00	32.00	25.00
Wakajaye	0.00	0.00	0.00	`0.00
Ex-Kwagiri	0.00	0.00	0.00	0.00
Dagbala	0.00	0.00	16.25	70.00
Egbe2	0.00	0.00	0.00	45.00
	ns	ns	ns	ns

Table 6: Number of flower produced by Jatropha landrace types
Different letters in the same column show that means are significantly different (p=0.05) according to Duncan's Multiple Rang Test

	Number of fruits (count)			
Varieties/landrace	**24WAS**	**26WAS**	**28WAS**	**30WAS**
Ode	3.25	1.75	1.50	0.00
Ege1	0.50	0.00	0.00	0.00
Ex-mbat-daya	0.00	0.00	0.00	0.00
Ex-dala	0.00	0.00	0.00	0.00
Ede	2.25	0.25	0.25	0.00
Wakajaye	0.00	0.00	0.00	0.00
Ex-Kwagiri	0.00	0.00	0.00	0.00
Dagbala	0.00	0.00	1.75	1.00
Egbe2	0.00	0.00	0.00	0.00
	ns	ns	ns	ns

Table 7: Number of fruits produced by Jatropha landrace types
Different letters in the same column show that means are significantly different (p=0.05) according to Duncan's Multiple Rang Test

	Number of harvested fruits		
varieties/landrace	**26WAS**	**28WAS**	**30WAS**
Ode	1.00	1.28	0.25
Ege1	0.00	0.00	0.25
Ex-mbat-daya	0.00	0.00	0.00
Ex-dala	0.00	0.00	0.00
Ede	1.75	0.00	0.00
Wakajaye	0.00	0.00	0.00
Ex-Kwagiri	0.00	0.00	0.00
Dagbala	0.00	0.00	0.00
Egbe2	0.00	0.00	0.00
	ns	ns	ns

Table 8: Number of harvested fruits of Jatropha landrace types
Different letters in the same column show that means are significantly different (p=0.05) according to Duncan's Multiple Rang Test

- **Pod weight per plant**
  The highest pod weight of 5.88 was indicated for Ode landrace but not significant differently from Ede that gave 2.45g except Egbel and Dagbala other landraces (Table 9)) and fig. 8.
- **Number of seeds per plants**
  Ode landrace recorded 6.00 and Ede landrace recorded 4.50 and were not significant difference from each other (Table 9)). This is equivalent to 10t/ha and 7.5t/ha.
- **Seed weight per plant**
  The highest weight of 3.98g was recorded for Ode landrace and was not significant different from other landrace types that produced no fruit at time of the trial (Table 9)).

Varieties/landrace	**Pod wt/pt. (g)**	**No. of seed/ pod (Count.)**	**Seed wt/plant (g)**	**No of pod/plt (Count)**
Ode	5.88	6.00	3.98	2.50
Ege1	0.25	1.25	0.50	0.25
Ex-mbat-daya	0.00	0.00	0.00	0.00
Ex-dala	0.00	0.00	0.00	0.00
Ede	2.43	4.50	3.20	2.00
Wakajaye	0.00	0.00	0.00	0.00
Ex-Kwagiri	0.00	0.00	0.00	0.00
Dagbala	0.29	1.00	0.33	0.13
Egbe2	0.00	0.00	0.00	0.00
	ns	ns	ns	ns

Table 9: Comparative pod characteristic and yield of nine Jatropha landrace types
Different letters in the same column show that means are significantly different (p=0.05) according to Duncan's Multiple Rang Test

4. Conclusions and Recommendation

Global production of biofuels is growing steadily and will continue to do so in other to stimulate the economic growth, social upliftment and poverty alleviation within marginalized communities. The experiment evaluates the agronomic performance of the

different landrace types for their productive. Morphological characteristics were similar for all the landrace types but not significantly different from each other except Ex-mbat-daya that shows a poor performance.
From the parameters observed on the field, Ode, Ede and Dagbala landrace types perform better all through, showing a higher value for the different Agronomic features like plant height, and stem girth. With regard to number of leaves, Dagbala, Egbe2, and Ede performed well while Ode and Egbe1 landrace types produced higher branching.
Early flowering and fruiting of the Jatropha landraces was observed for Ode and Ede landraces at 18WAS and 22WAS, the least performance occurred mainly with Ex-mbat-daya landrace. Ode and Ede landraces shows higher weight of seeds of 3.98g and 3.20g respectively and is equivalent to 6,633.3plt/ha for Ode and 5,333.3plt/ha for Ede landrace type.

5. Recommendations

Although some parameters were not considered during the time of collection that would have given more detail research information on chemical composition of the seeds, leaves and stem but research work will therefore be recommended for farmers who are interested in the cultivation of jatropha plantation for its biodiesel and medicinal purposes. However, further research can also be carried out to ascertain the authentic of this observation.

6. References

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11. Database 4.0

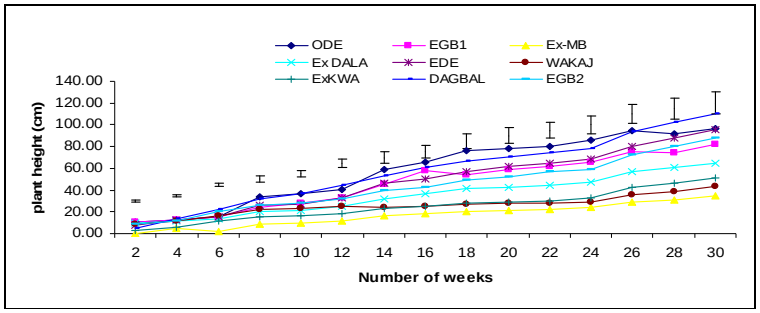

Figure 1: Responses of Jatropha landrace types to plant height (cm)

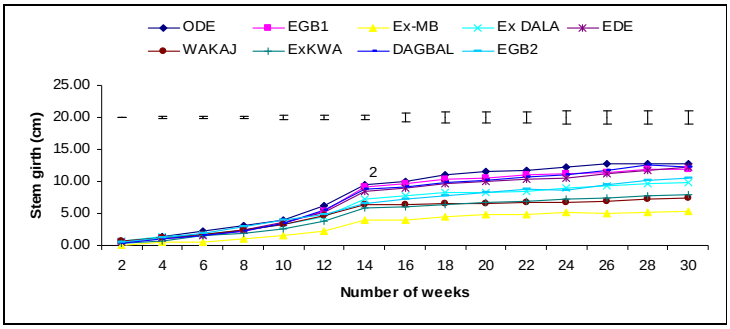

Figure 2: Responses of Jatropha land types to stem girth (cm)

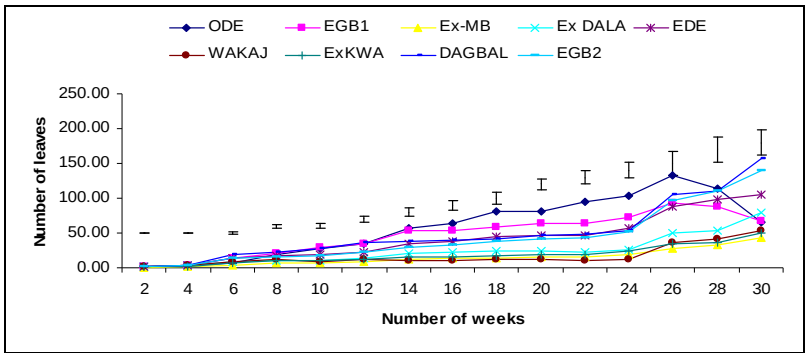

Figure 3: Responses of Jatropha landrace types to number of leaves (counts)

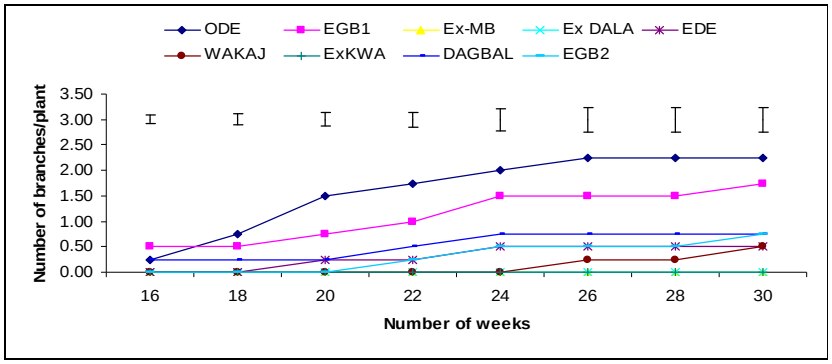

Figure 4: Responses of Jatropha landrace types to primary branching produced

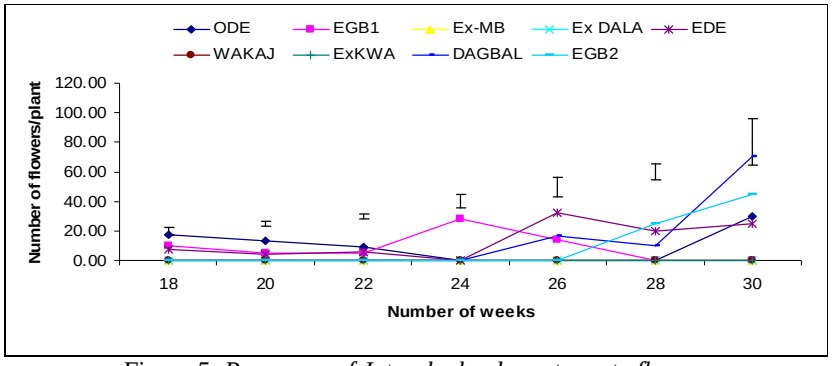

Figure 5: Responses of Jatropha landrace types to flowers

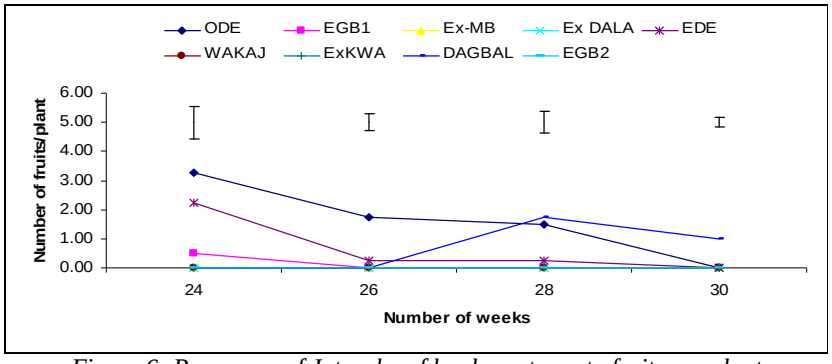

Figure 6: Responses of Jatropha of landrace types to fruits per plant

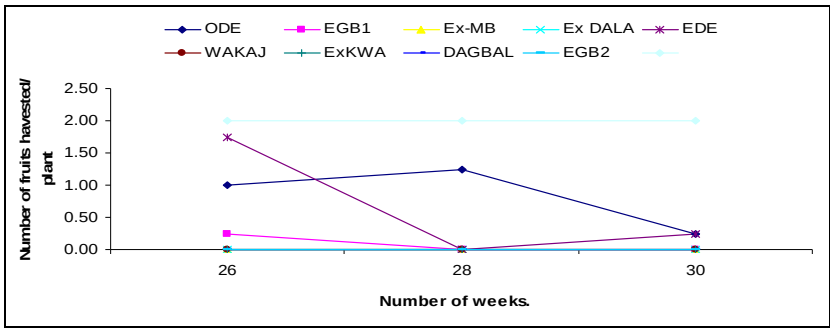

Figure 7: Responses of Jatropha landrace types to Number of fruits harvested/plant

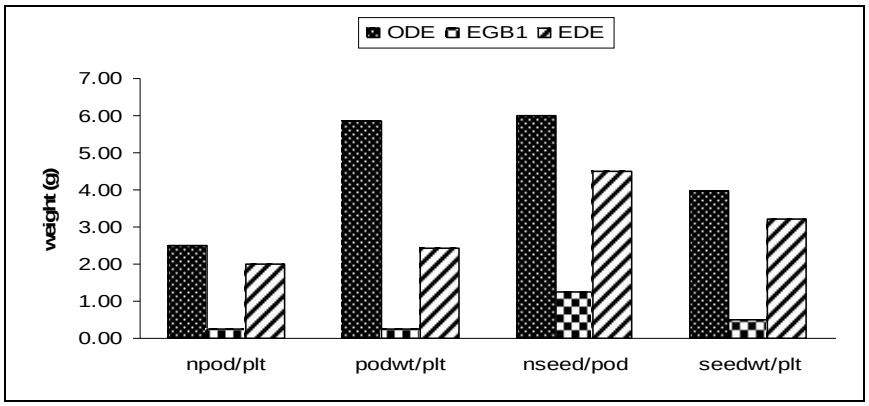

Figure 8: Comparative pod characteristics and yield of Jatropha landrace types