Biodiversity of Castorbean in Egypt- For The Potential Possibility of Using as a Bioenergy Crop

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Outlines

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- Objectives of Study
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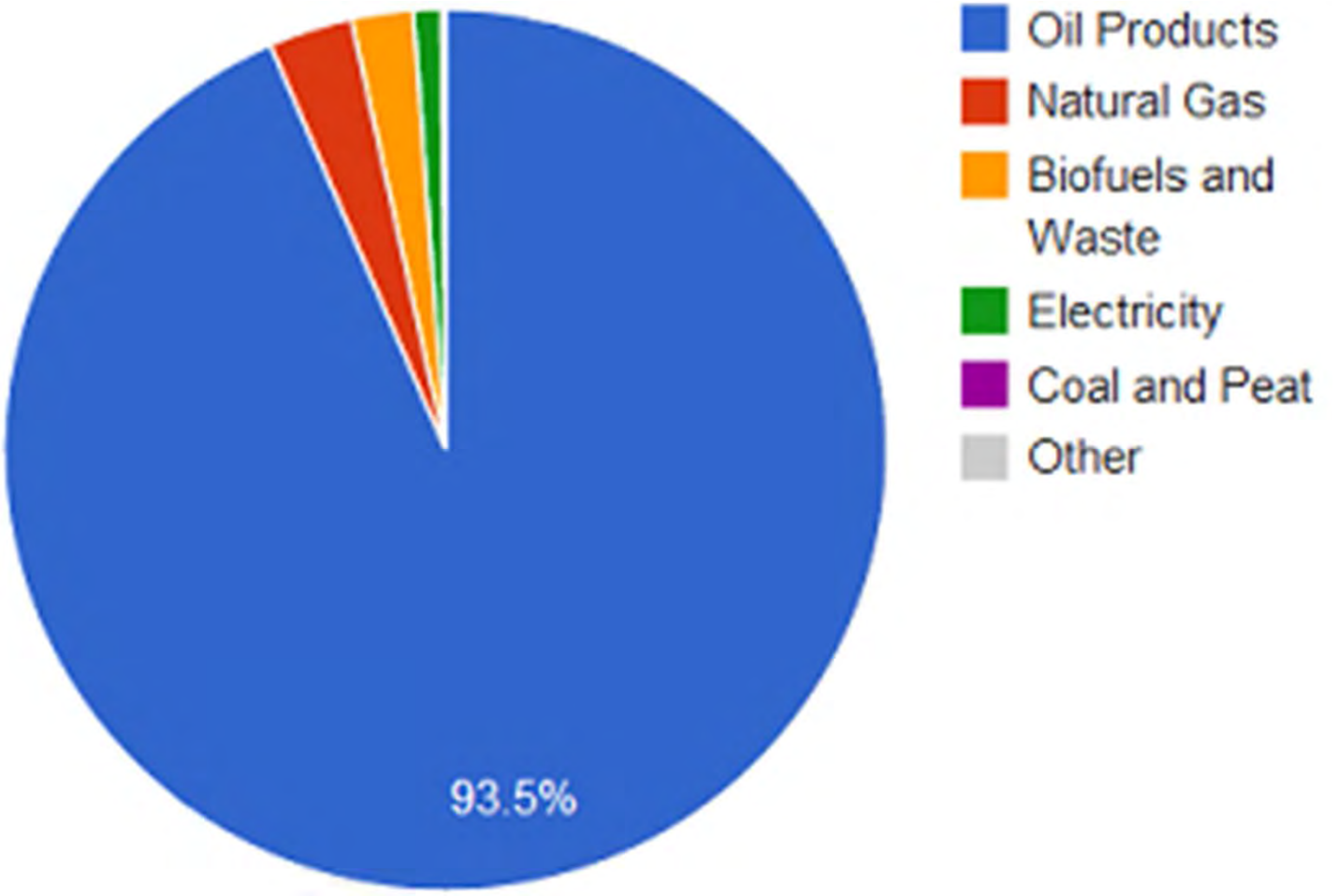
- General conclusions and implications
- References

Introduction

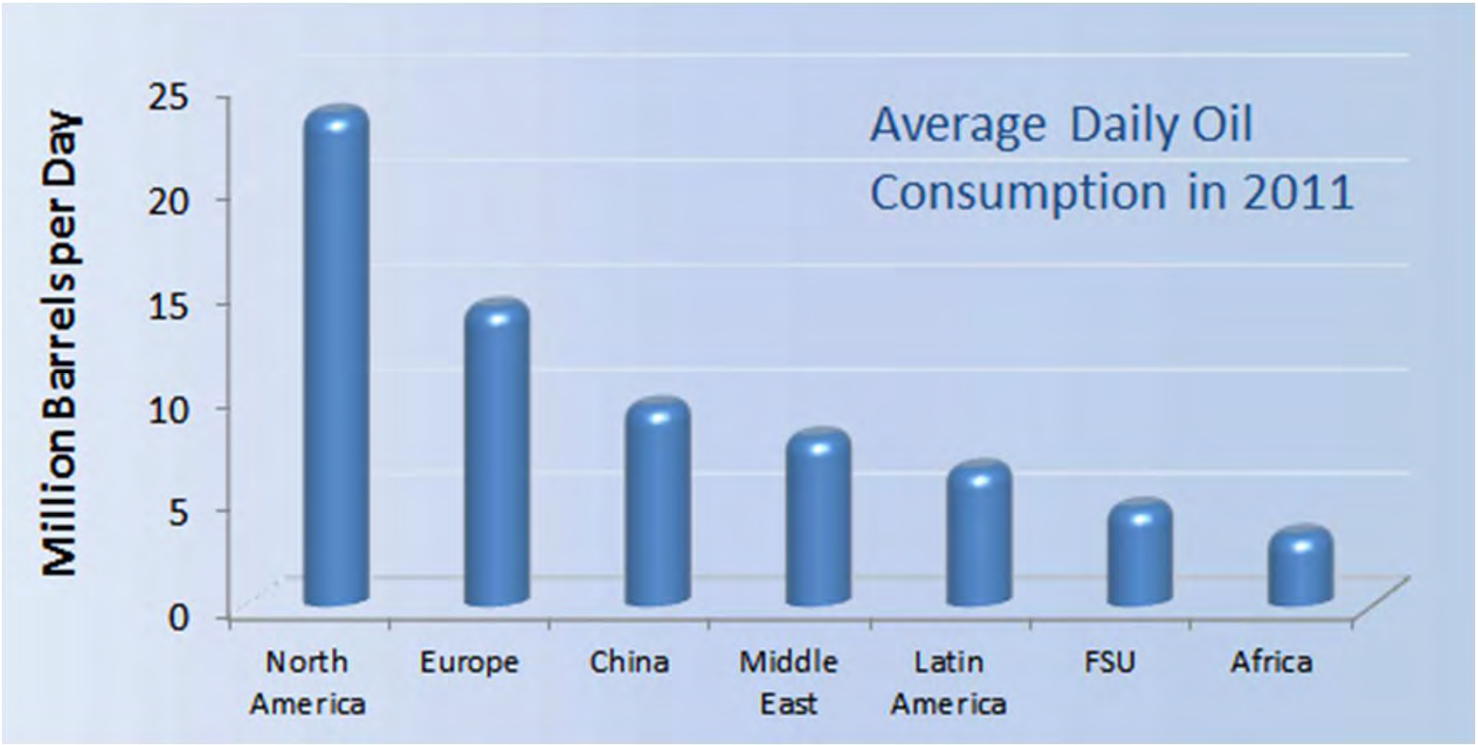


Source: International Energy Agency (IEA) data, 2009

World Transportation Energy

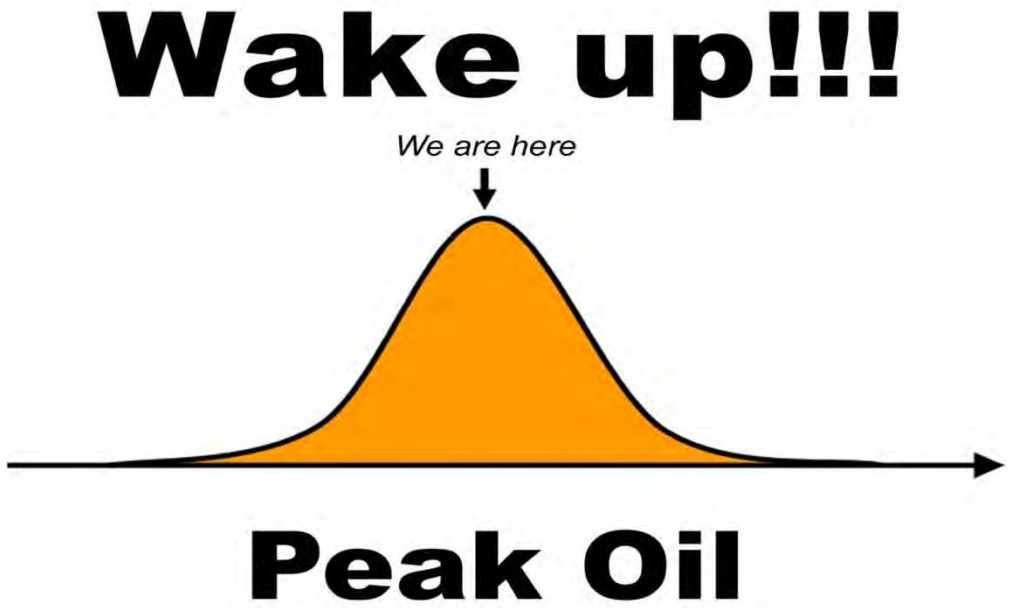
World Oil Consumption

- 88 million barrels a day (IEA, 2011).
- 95 million barrels a day in 2016 (IEA, 2011).



Source: simplifying the global oil balance by market analyst Dan , May 13, 2012

- Associated with adverse impacts on climate change (McKibbin, 2010).



- Limited resource whose production will soon decline (Bentley,2002).
- Alternatives resources.
- Type of Renewable Energy derived from the Sun (US Dept. of Energy).
- Common biofuels : 1- Ethanol 2- Biodiesel.

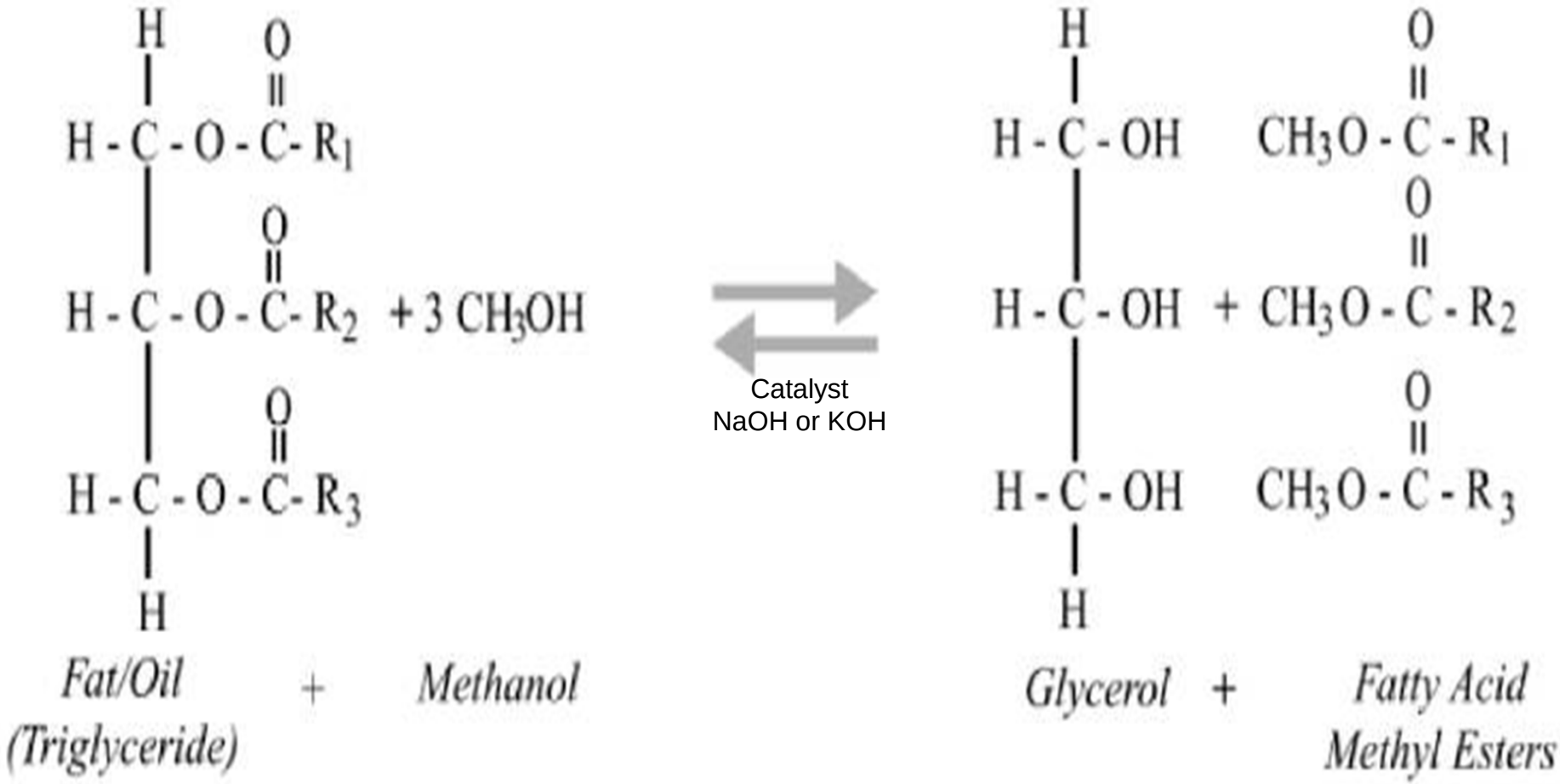
Biodiesel

- Made from vegetable oils or animal fats (EPA,2007).
- Rapeseed, Soybean, Maize, Cotton, Sesame, Sunflower, Olives, Palm, Castor, Jatropha.
- Pure or mixed (Stamenkovic *et al* ., 2013).

Obstacles:

- 1- Require purification with H2O: Dry washing Mg silicate (Berrios, & Skelton, 2008).
- 2- High cost : 0.5 US$/L =1.5 times > that of fossil diesel (You *et al*., 2008).

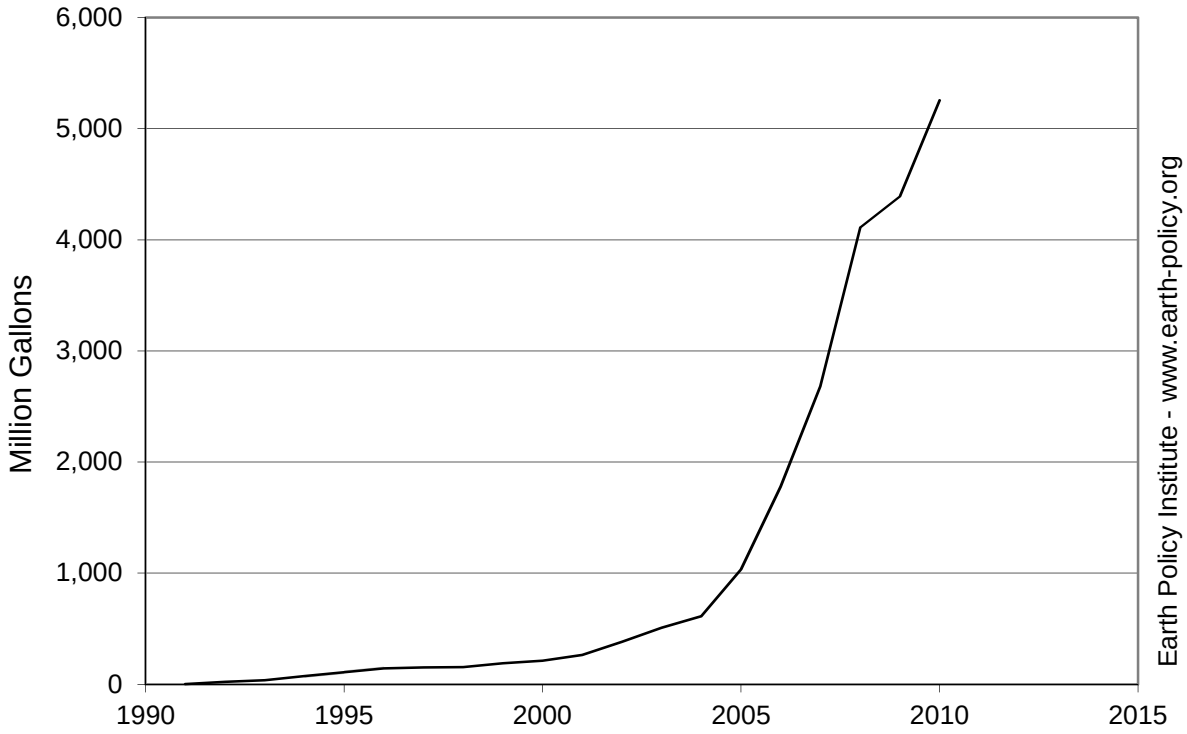
Transesterification



Source: national biodiesel board,2013

World Production

- In 2010: 5 Million Gal. = 20 Million liters.
- EU, US, Argentina and Brazil (FAO,2013).



Source: Compiled by Earth Policy Institute with 1991-1999 data from F.O. Licht data, cited in Suzanne Hunt and Peter Stair, "Biofuels Hit a Gusher," *Vital Signs 2006-2007* (Washington, DC: Worldwatch Institute, 2006), pp. 40-41; 2000-2004 data from F.O. Licht, *World Ethanol and Biofuels Report*, vol. 7, no. 2 (23 September 2008), p. 29; 2005-2010 data from F.O.Licht, *World Ethanol and Biofuels Report*, vol. 8, no. 13 (15 March 2010), p. 265.

Advantages

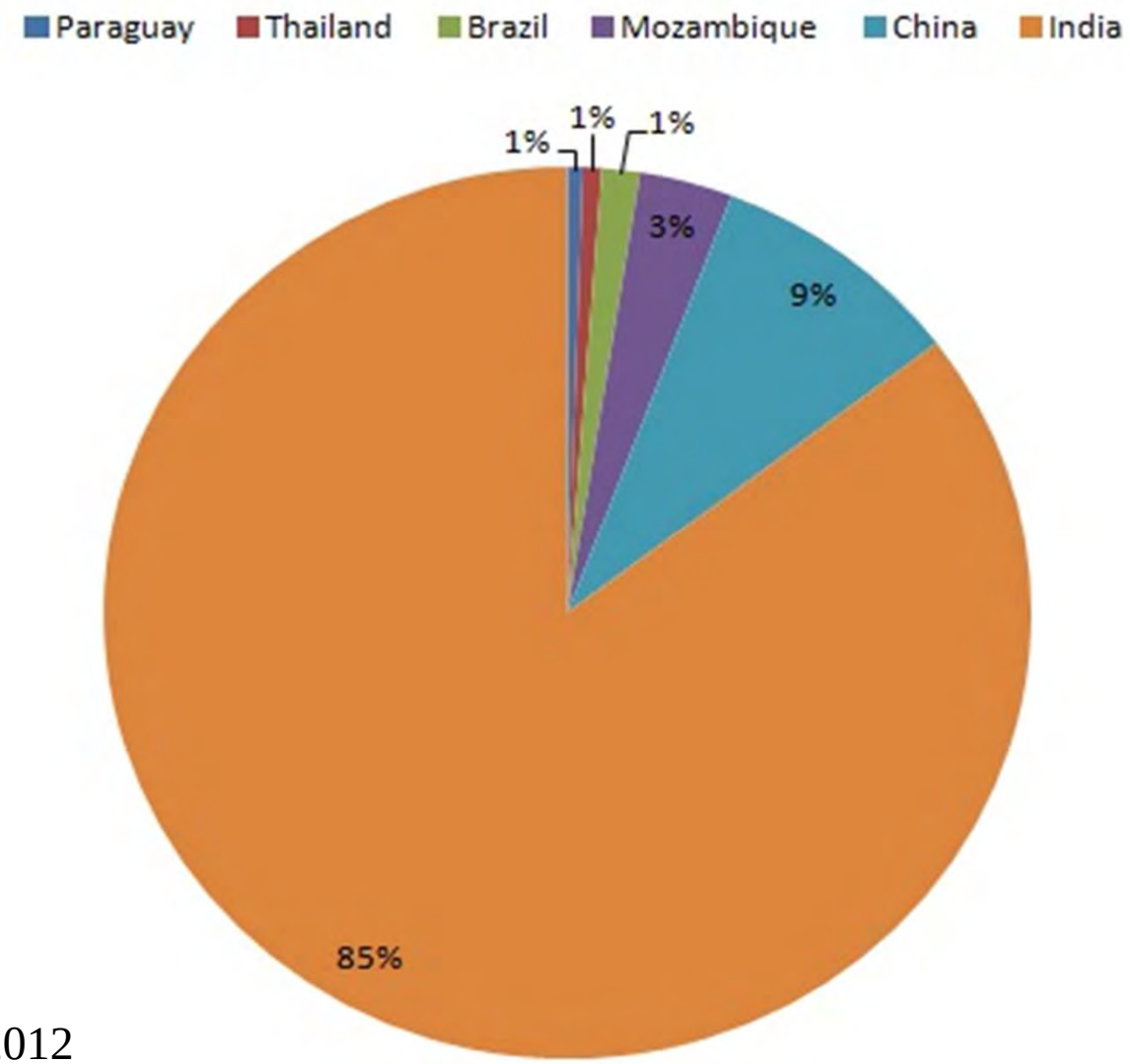
1. Eco friendly: Absorb CO2 > that added (Stamenkovic, *et al*.,2013)
2. Reduced greenhouse gas emissions (Frondel, and Peters,2007).
3. Safe and non toxic (Stamenkovic, *et al*.,2013).
4. Biodegradable (Stamenkovic, *et al*.,2013).
5. Free from SO2 (Stamenkovic, *et al*.,2013).
6. Reduced country's reliance on foreign oil.
7. Improved energy security.
8. Stable energy supply.
9. Enhanced rural development (Huang *et al*., 2012).

Castorbean a Biodiesel Source For The Future of Egypt

R. communis

- Euphorbiaceae (Bhojani *et al*., 2012).
- Drought resistant, ideal for semiarid regions (Umamaheswari, 2006).
- Cultivated in tropical and subtropical regions (Govaerts *et al*., 2000).
- Low impute costs and High yielding: 1.2 -1.8 tons ha-1 (Labalette *et al*., 1996).
- Provides a viable income (US $ 850-1000 / Ton).
- Easy to grow and Fast growing (Doan, 2005). 4- 6 monthes.
- Not compete with food crops (Ogunniyi, 2006).

- The world production 1.95 million tons (FAO, 2012).
- Cultivated on commercial scale in 31 countries (FAO, 2012).



Source: FAO, 2012

- Grow well on all soils.
- Low fertility soil (Cheema, *et al.*, 2013).
- Seed yields may be low on fertile soils (Hattam &Abbasi, 1994).
- Grow in both irrigated and rainfed ecologies
- Requires moderate rainfall 400- 600 mm (Hattam &Abbassi, 1994).
- In irrigated areas, 4-6 irrigations.
- Excessive water reduces yield, oil contents, seed weight and plants become susceptible diseases (Kolte, 1995).

Pharmaceuticals,Manufacturing of cosmetics, soaps, coatings, inks, dyes ,cold resistant plastics, waxes , nylon, lubricants, lighting (Berman *et al*., 2011).

N (6.4%), P (2.5%), K (1%), and crude protein 32% (Rao, 2004).

Hyperaccumulator Pb soil contaminated (Romeiro et al.2006).

At the maturity

Feeding silkworms (**Cheema** *et al., 2013)*.

C3 plant, Absorb CO2 (35 tone ha-1, with 2 growing cycles per year) (WWW.DOVEBIOTECH.COM)

Biodiesel from castor oil

- Seed contains 40- 50% oil, which is rich in tryglycerides.
- Castor oil Biodiesel has several advantages over other vegetable oils due to:

- Low levels of residual P and C (Ogunniyi, 2006).
- Absence of aromatic hydrocarbons (Scholz & Silva, 2008).
- High cetan number and high quality.
- Solubility in alcohol and Does not require heat in transforming into fuel (Berman *et al*., 2011).

Biodiesel from castor oil problem

- High viscosity (Ricinoleic acid%) limiting factor for the use pure castorbean diesel in the engines (Pinzi et al., 2009).
- Blended with petrodiesel regions with severe winter (Singh, 2011).
- Low freezing point, It preventing fuels from freezing at extremely low temperatures (Berman et al., 2011).

- There are nearly 250 cultivars of castor (Ovenden *et al*., 2009).
- There is a wide variation: Vegetative traits : leaf and stem colors, presence of wax on stem (Savy-Filho, 2005). Reproductive traits: as color and size of seeds (Popova and Moshkin, 1986).

Development of new cultivars:

- Available knowledge about genetic diversity (Gepts, 2004).
- Characterize the genetic diversity present across *R. communis* germplasm from different locations (Hinckley, 2006).
- Morphological characterization is the first step in the description of germplasm collections (Smith *et al*., 1991).

Aim and objectives

- This work aimed to highlighting castor bean importance, for possible extensive plantation in arid regions of Egypt. Specific objectives include:

1- Characterize the genetic diversity present across *Castor* germplasm from different locations in Egypt.

2- Compare and evaluate some castor bean landraces in terms of morphoagronomic characters, to explore the potential possibility of using as a bioenergy crop in Egypt.

Materials and Methods

- Collected seeds from various locations.
- Studied physical characterization.
- Open filed experiment
  - Research farm of Soils and Water Department, Nuclear Research Centre
  - Sandy soil.
  - RCBD with 3 replicates.
- The planting space was 2x3m.
- Recommended agronomic practices were carried out.
- Harvest

Parameters measured

1. Plant height (cm)
2. Leaves fresh and dry weights (g)
3. Main spike length (cm).
4. No. of spikes plant^{-1}
5. No. of capsules plant^{-1}
6. No. of seeds plant^{-1}
7. 100-seed weight (g)
8. Seed yield plant^{-1} (kg)
9. Seed yield hectare^{-1} (ton)
10. Oil percentage (%)
11. Oil yield hectare^{-1}
12. Fatty acids profile

Results

Physical properties

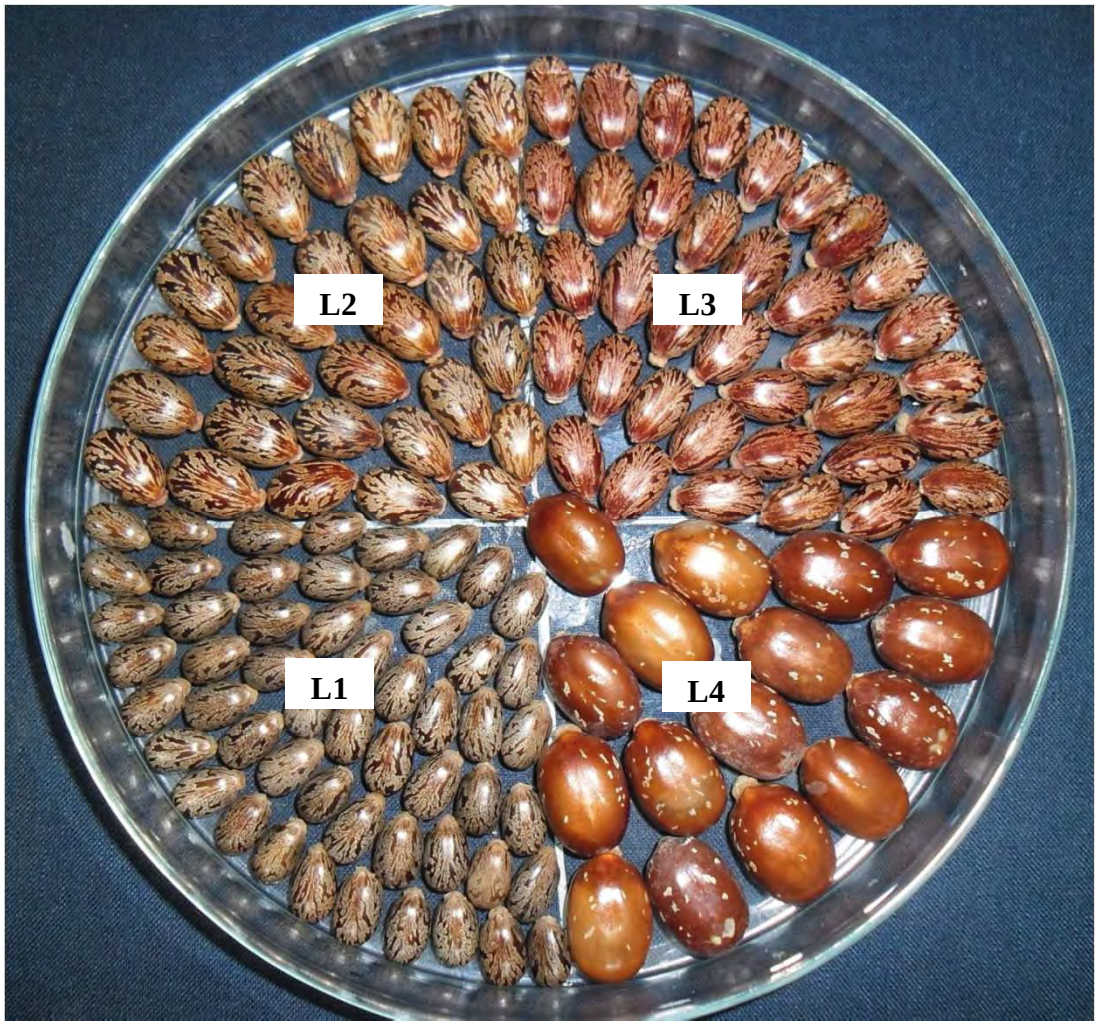


Fig. 1.b. Representation of the variability in color and size observed among seeds of castorbean collected from different locations in Egypt.

Physical properties

Castor Landraces		Seeds weight (g)	Seeds height (cm)	Seeds width (cm)	Seeds thickness (cm)
L1	GSSL	0.20	0.90	0.50	0.30
L2	BMSL	0.50	1.55	0.86	0.60
L3	RMSL	0.48	1.40	0.85	0.60
L4	BLSL	**0.70**	2.2	1.30	0.53

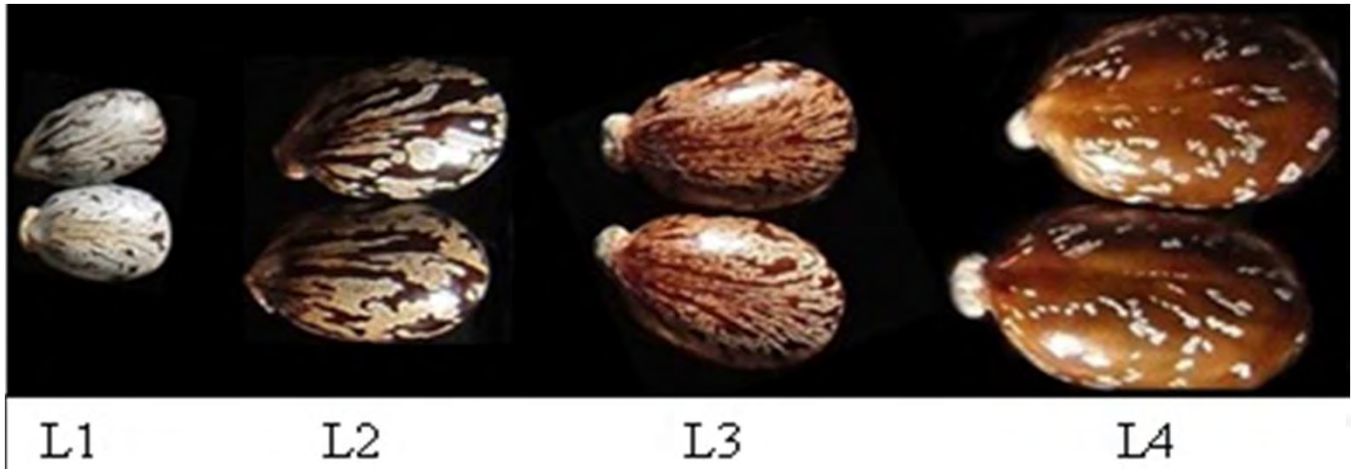


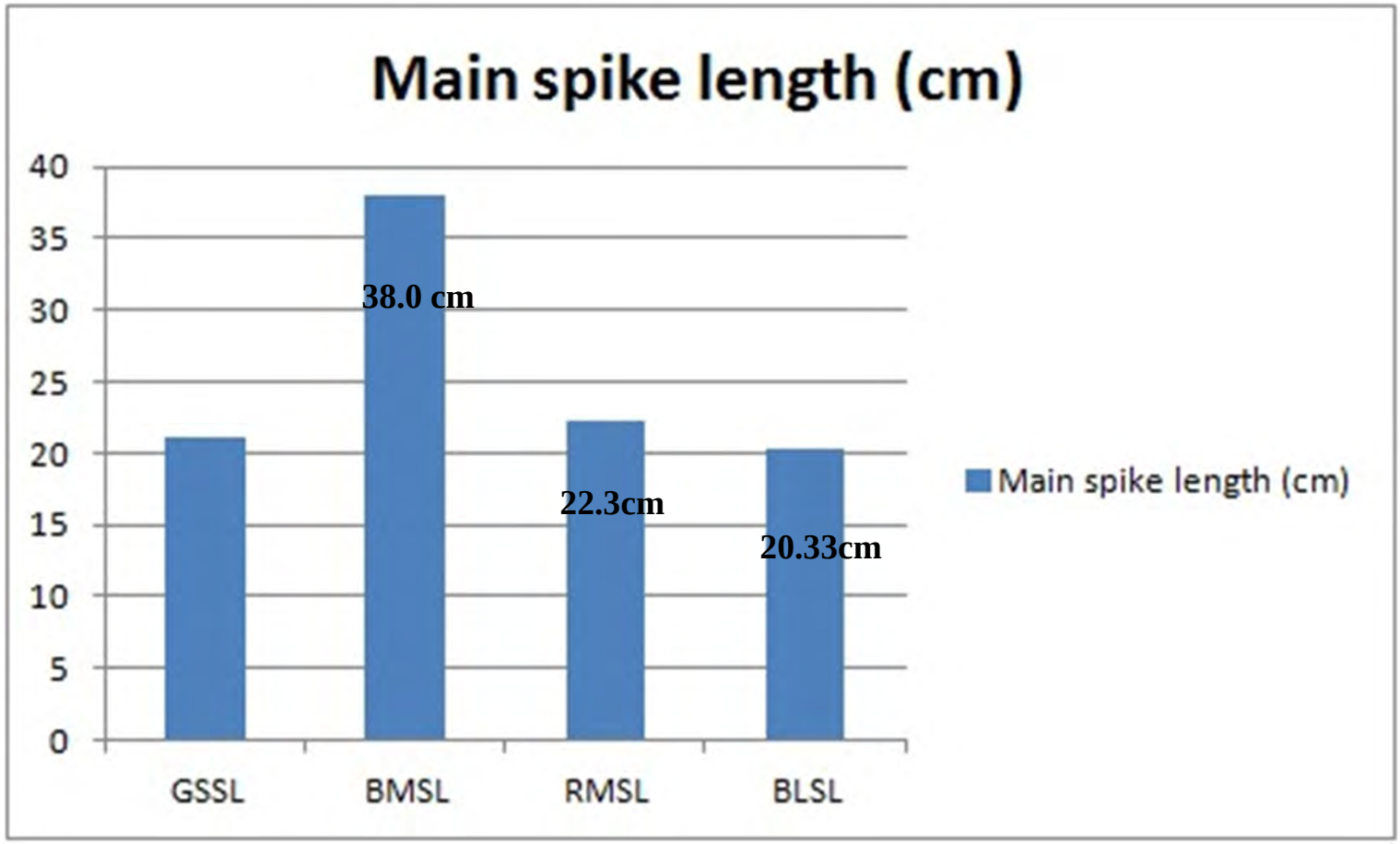
Table 1: Plant height, Leaves weight, Leaves petiole length Number of branches per plant for the four castor bean landraces

Castor bean Landraces		Ph (cm)			L FW (g)			LDW (g)		
		M		SD	M		SD	M		SD
L1	GSSL	263.3	±	12.6	8.33	±	0.59	2.36	±	0.28
L2	BMSL	288.3	±	10.4	17.56	±	0.52	4.84	±	0.61
L3	RMSL	320.0	±	20.0	14.52	±	1.44	3.69	±	0.88
L4	BLSL	228.3	±	15.3	15.09	±	0.38	4.40	±	0.67
L.S.D		28.24			1.58			1.21		

* The data represent mean ± SD of three replicates, GSSL= Gray small seeded landrace, BMSL= Brown medium seeded landrace, RMSL= Red medium seeded landrace, BLSL= Brown large seeded landrace, L.S.D. = least significant differences of means (5% level).

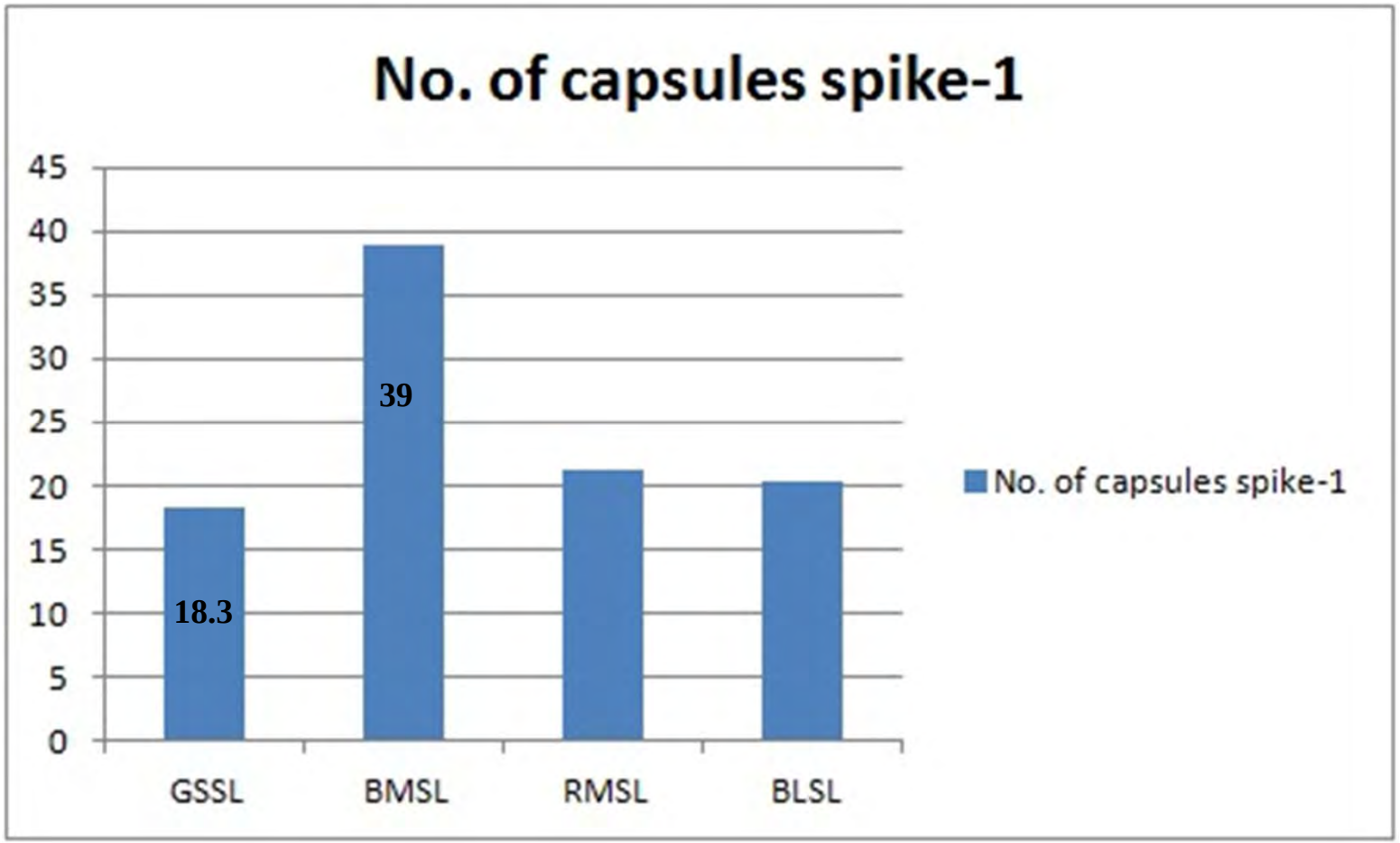
Main spike length (cm)

- Sarwar *et al*., (2010) Play a significant role for improving yield if selection is based on it.



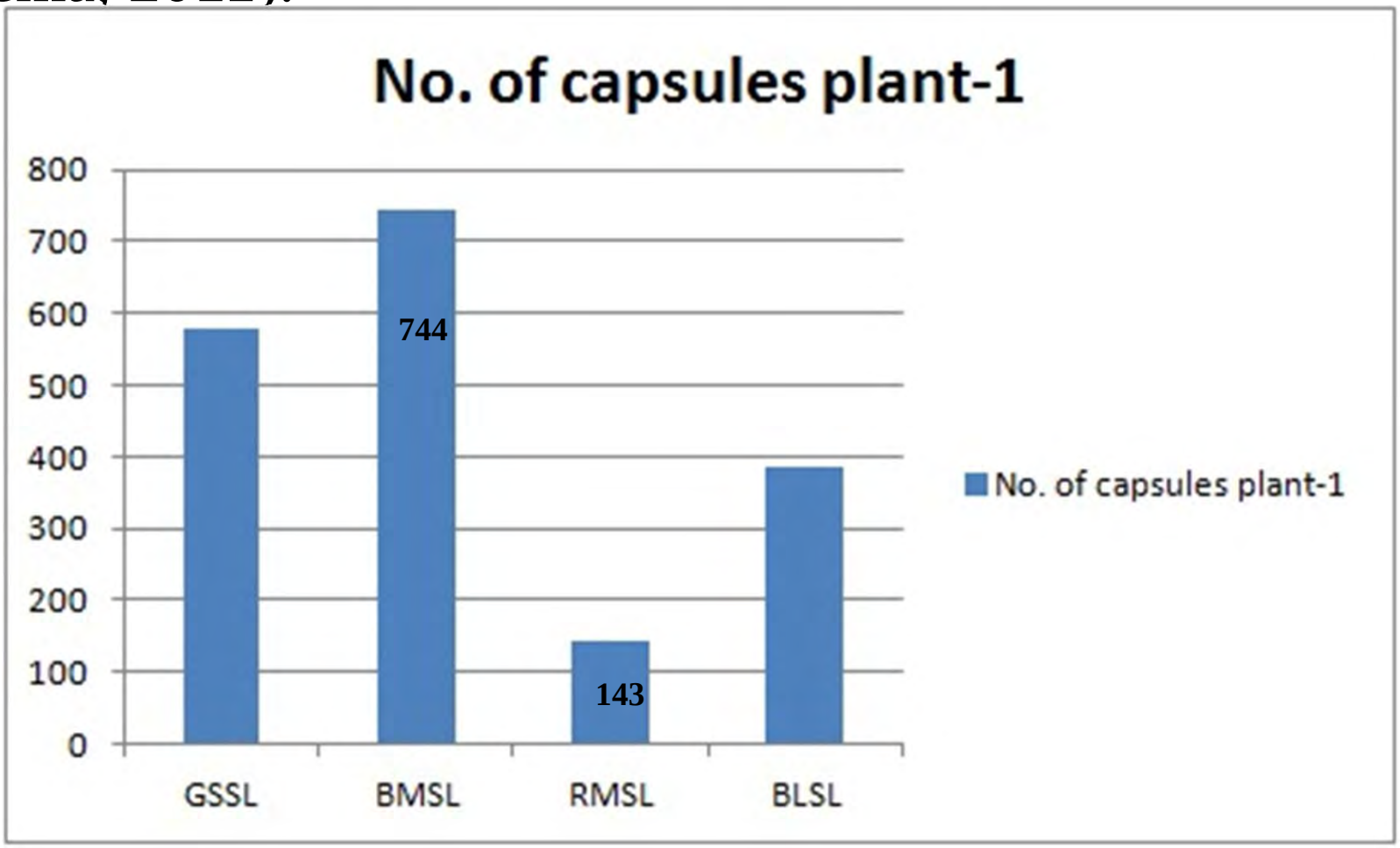
Number of capsules spike-1

- Play a significant role for improving seed yield if selection is based on it (Sarwar *et al*., 2010).



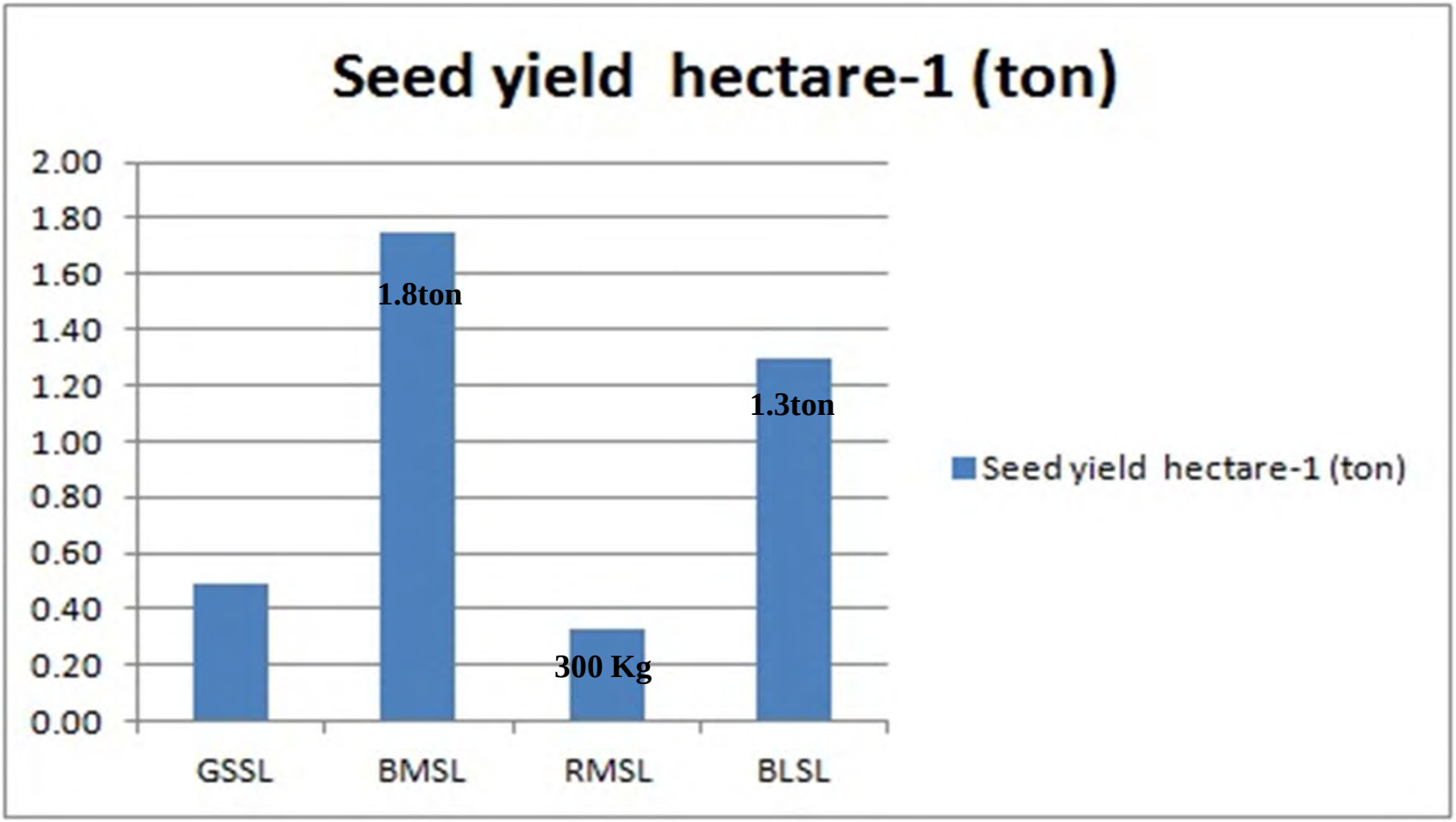
Number of capsules plant-1

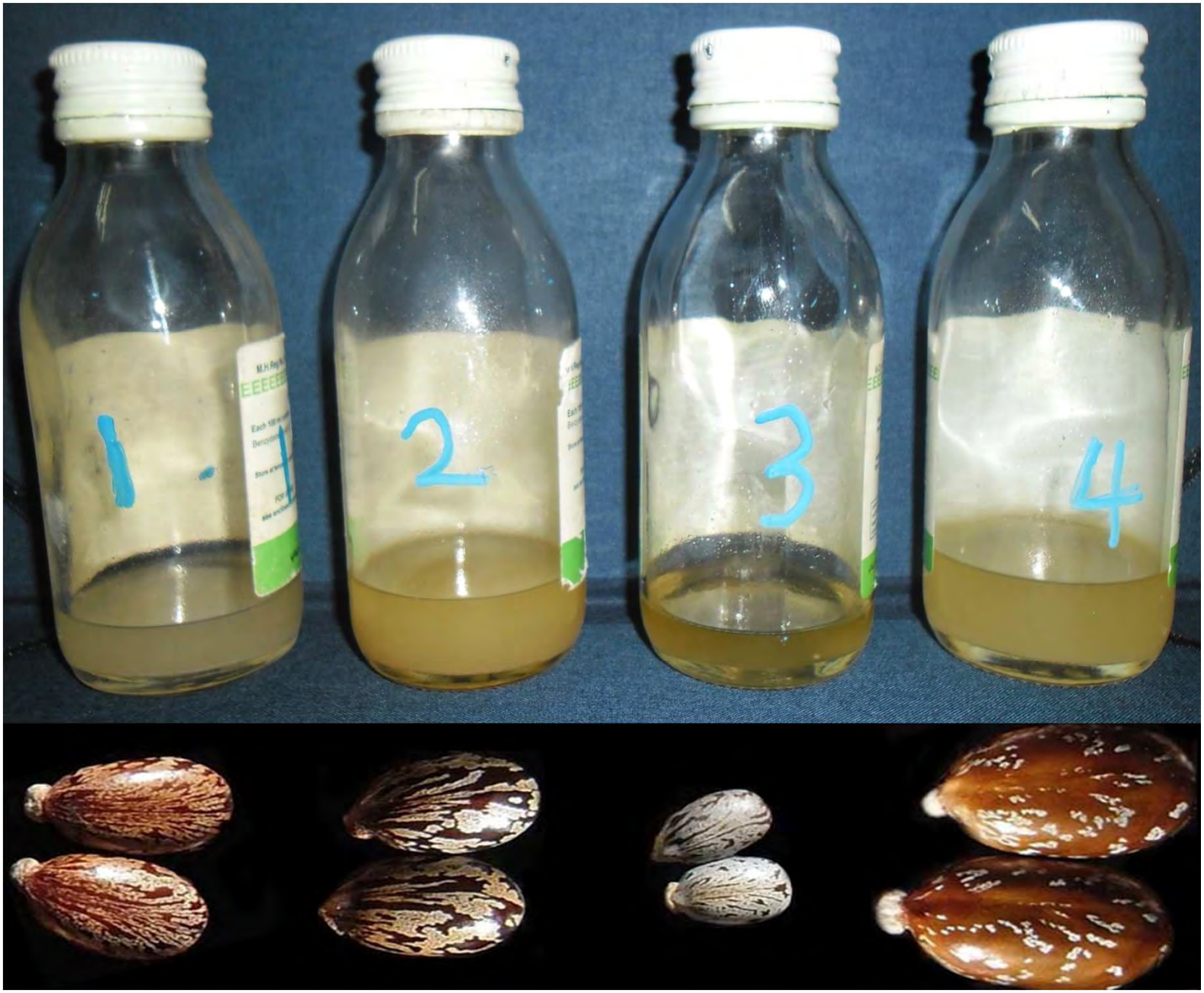
- It is important components contributing to the yield (Cheema, 2011).



Seed yield hectare-1 (ton)

- It is important parameter from a farmer's point of view (Cheema, 2011).





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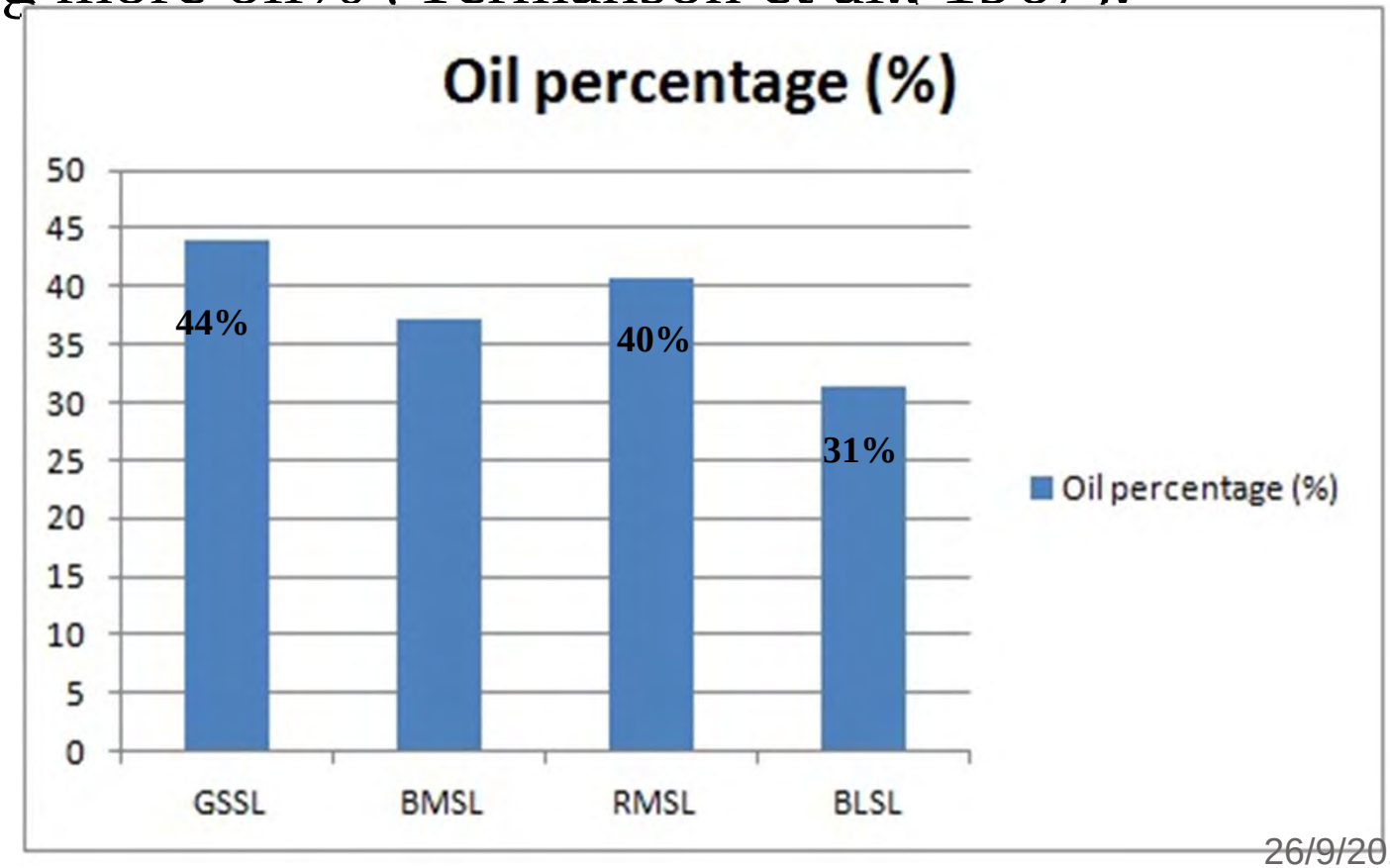
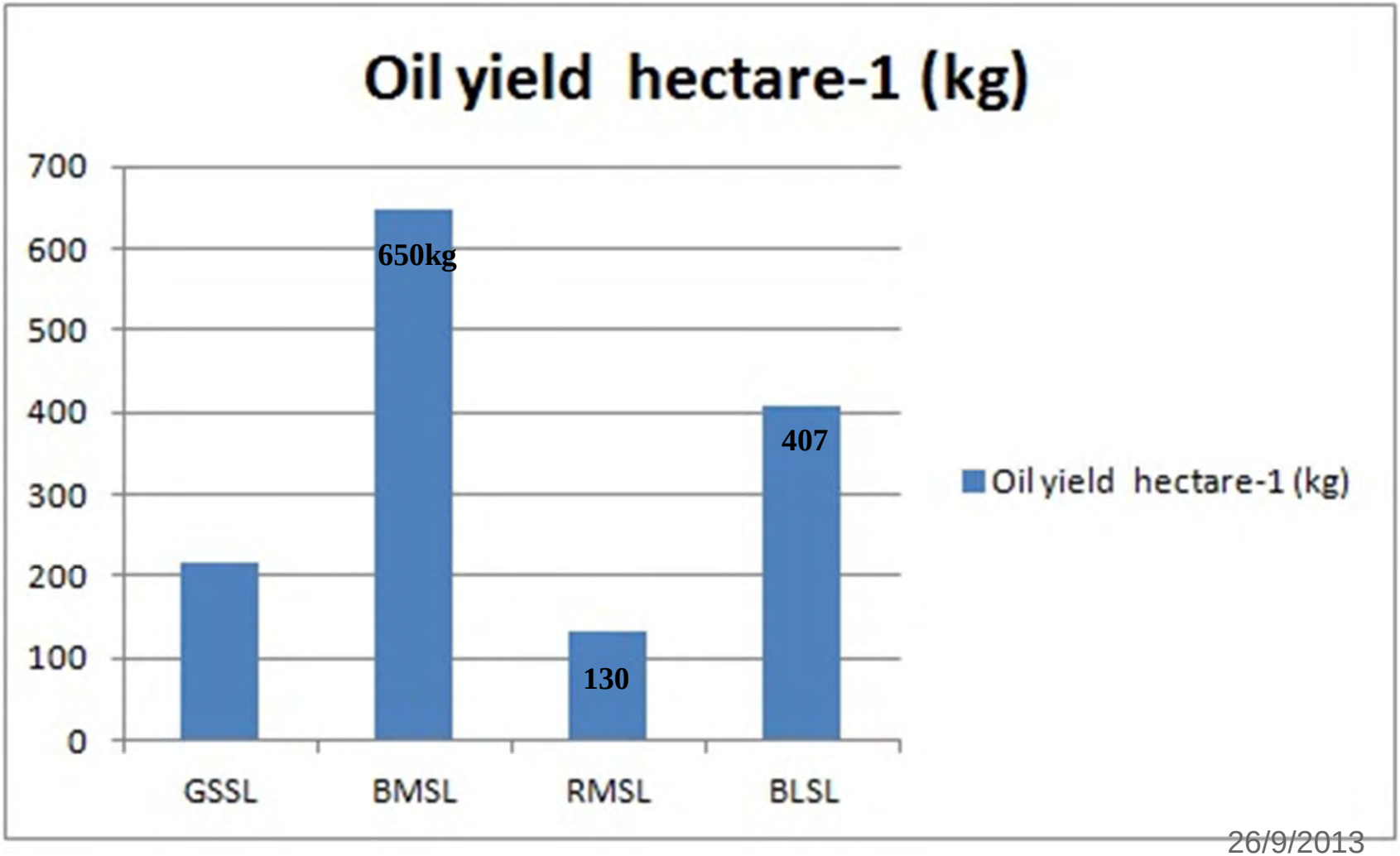
Oil percentage (%)

- Castor bean has been traditionally cultivated for the production of lubricants and paints (Berman et al., 2011).
- Small grains have less percent of skin and therefore containing more oil% (Yermanson et al., 1967).



Oil yield ha-1

- Oil Yield = Grain yield × oil%.



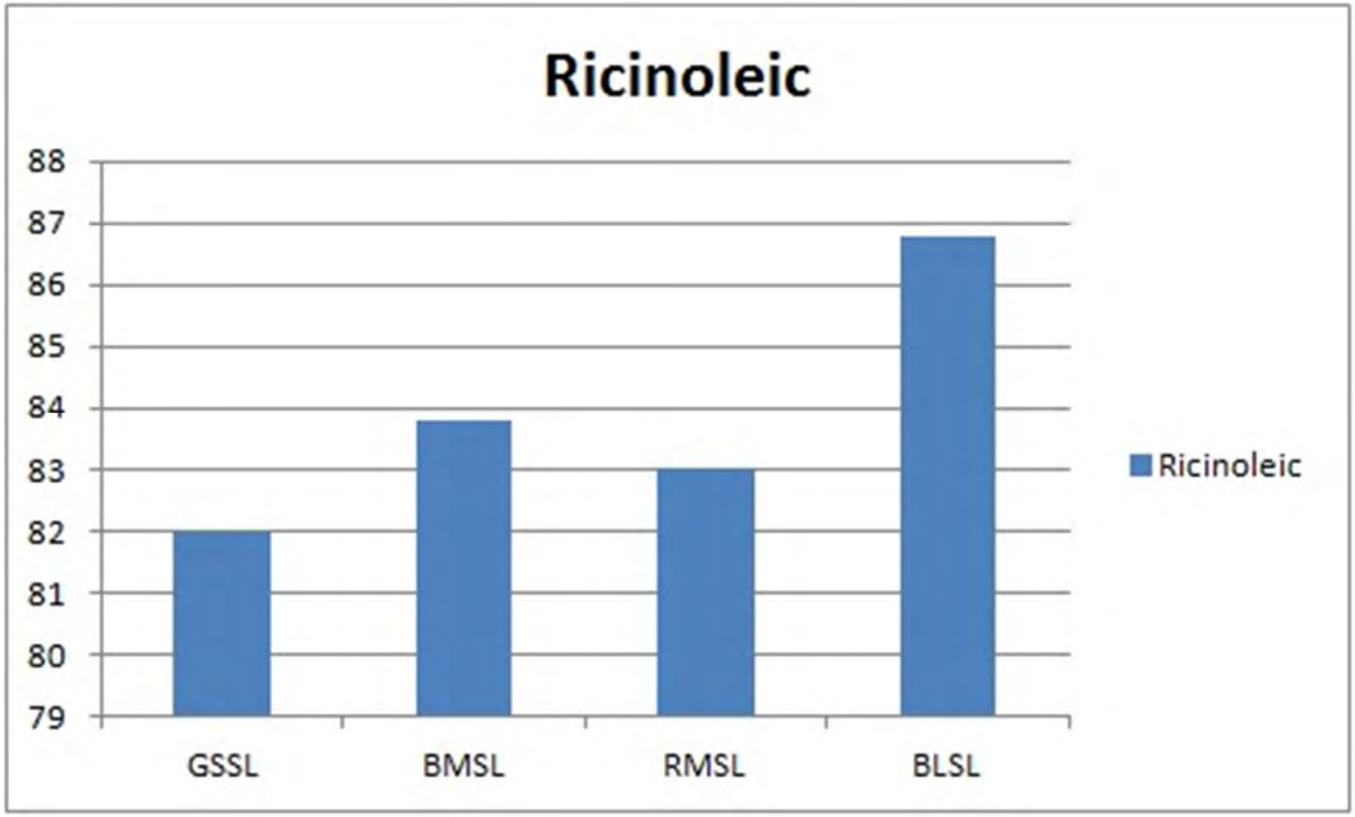
Fatty acids profile

- Palmitic, Stearic, Oleic, Linoleic, and Ricinoleic Acids.

Castor Landraces	Palmitic	Stearic	Oleic	Linoleic	Ricinoleic
GSSL	1.64	3.40	8.30	4.70	81.96
BMSL	1.80	1.40	3.70	9.30	83.80
RMSL	1.50	1.00	7.10	7.40	83.03
BLSL	2.80	0.60	0.10	9.70	86.80

Ricinoleic acid

- Most important constituent (Cheema,2011).
- Good quality oil = oil having high content of Ricinoleic acid (Cheema,2011).
- A slight variation was noted, ranging from 82 - 87%.



Conclusions (up to now...)

- Despite being an important crop, castorbean has never been realized as a commercial crop in Egypt.
- It is grown on marginalized land without giving much care and attention.
- Based on seed size, and color 4 castorbean landraces were discovered: the small seeded landrace, the medium seeded landrace, and the large seeded landrace.
- The brown medium seeded landrace, and the brown large seeded landrace with a high seed yield, oil content and proper fatty acid composition could be a good source for biodiesel production.

Policy implications

- Castor bean could be an agricultural solution for arid regions of Egypt that addresses the need for commercial crops with low impute costs and at the same time provides traditional farming with a viable income from current non productive lands.
- Castor cultivation emerges as a promising activity for biodiesel production. This will contribute directly to the economy of the poor resource base farmer in Egypt.

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Thank you for your time and attention!

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