is close to zero. The temperature and sea-level behaviour are clearly not driven by the anthropogenic CO_2 emission, but they are more likely natural.

The quasi 60-year oscillation of temperature, the recovery of temperatures since the end of the Little Ice Age and the isostasy and subsidence of land are all well-known. What is not known is why we should read models already failing validation in their original formulation that are revised to push even further the already exaggerated warming. With anthropogenic global warming having vanished since 2000 at the end of the latest upward phase of a quasi 60-years oscillation, it is unlikely that the global temperatures will increase by 4°C in the remaining years of this century.

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A. PARKER

Royal Melbourne Institute of Technology University,
Bundoora, VIC 3083, Australia
e-mail: albert.parker@rmit.edu.au

Camelina sativa: success of a temperate biofuel crop as intercrop in tropical conditions of Mhow, Madhya Pradesh, India

Camelina sativa or false flax is an oil-yielding plant of the family Brassicaceae. It is an annual crop of the temperate region. It is also a self-pollinating and autogamous plant[1]. The most acceptable chromosome number for this plant is $2n = 40$ and other values could be due to variation among populations[2]. It can be sown on frozen grounds as well[3]. The plant is gaining popularity as a feedstock for bio-diesel in Europe and North America[4]. Yield potential of *Camelina* is at par with Brassica[5]. It gives a good yield of 1987 to 3320 kg/ha (ref. 6). *Camelina* is a low-input crop and its nutrients requirement is also very less; hence it can be grown on marginal lands[7,8]. It has around 40% of oil content[9]. The possible industrial uses of *Camelina* include its use in cosmetics and bio-diesel fuels[10]. Wu and Leung[11] attempted to optimize bio-diesel production from *Camelina* oil through alkaline transesterification. Krohn and Fripp[12] studied the environmental feasibility of *Camelina* bio-diesel compared to petroleum diesel[12]. *Camelina* proved better due to its lower life-cycle energy than traditional bio-diesel crops like soybean and canola[12].

In India, Defence Institute of Bio-Energy Research (DIBER), a constituent Institute of Defence Research and Development Organisation (DRDO), is working on bio-diesel production from *Jatropha curcas* and is also doing research on *C. sativa*. Research is going on to standardize the agriculture packages of practices at its field stations and project sites in order to make it a viable source of bio-diesel. Intercropping trials of *Camelina* in *Jatropha* plantation were conducted at DIBER Project Site Biofuel Park at Harsola, Mhow, Madhya Pradesh from July 2012 to February 2013 at 15 days interval; these trials were repeated during 2013–14 to validate the data. Both line sowing and broadcast methods were tried. Plot size was 1 m^2 and plots per replicate were 8; line-to-line spacing was 20×30 cm. The average number of plants was 120/1 m^2 plot. All the inputs were optimized. It takes 5–9 days for germination. Flowering starts from 35 to 45 days of sowing and fruits set after 55–60 days of sowing. Data regarding vegetative parameters such as plant height, number of branches per plant, shoot and root mass and reproductive parameters such as number of pods per plant, number of seeds per pod, seed yield per plant and yield per plot were recorded (Table 1). *C. sativa* can be grown in the tropics

Table 1. Vegetative growth and reproductive yield parameters of *Camelina sativa* during 2012–13

Parameter	Sowing month							
	July	August	September	October	November	December	January	February
	(Range of parameters)							
Days taken for germination	5–6	5–6	5–6	6–7	5–6	6–7	6–7	6–7
Plant height at maturity (cm)	55–68	58–68	65–69	81–84	66–69	62–67	60–63	58–60
Number of branches/plant	6–8	6–8	9–11	13–15	10–12	7–9	7–9	6–8
Shoot mass/plant (g)	15–17	16–18	19–21	22–23	19–21	17–19	15–17	13–16
Root mass/plant (g)	1.2–1.8	1.7–2.1	2.0–2.2	2.5–2.7	2.1–2.4	1.7–1.9	1.6–1.9	1.5–1.7
Pods/plant	161–163	202–205	238–240	335–347	240–242	201–203	161–163	141–143
Seeds/pod	6–8	6–8	9–11	13–15	10–12	7–9	7–9	6–9
Seeds yield per plant (g)	0.65–1.15	0.89–113	1.3–1.6	1.7–1.9	1.3–1.6	1.1–1.6	1.0–1.2	0.6–1.10
Yield/1 m^2 plot (g)	75–77	82–84	113–115	216–219	170–172	91–93	62–64	53–55

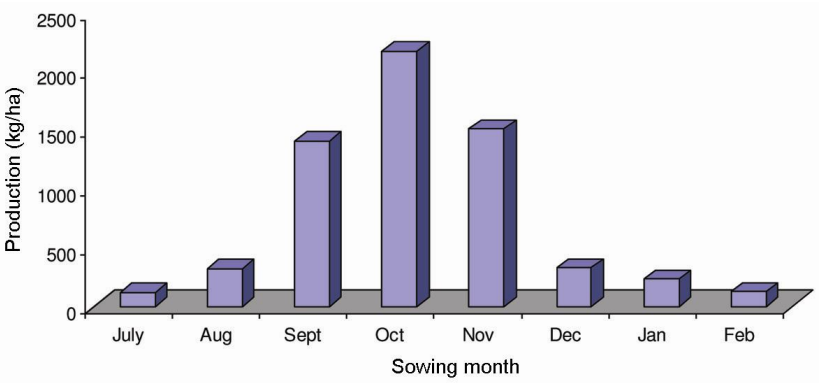

Figure 1. *Camelina sativa* production trend under tropical conditions at Mhow, Madhya Pradesh.

from August to February, but October was found most suitable for sowing the crop for obtaining optimum seed production. Average production during September–November 2012 was 1140, 2180 and 1710 kg/ha respectively. During 2013 seed production recorded was 1128, 2171 and 1682 kg/ha respectively. The variation in seed yield during 2012 and 2013 was less, thus confirming the reproducibility of the data. October-sown *Camelina* crop yield was found maximum, i.e. 217–218 g/m^2 (2171–2180 kg/ha). Figure 1 shows month-wise production trend of *Camelina* at DIBER Project Site, Mhow during 2012–13.

Thus it can be concluded that *C. sativa* is a short-duration (85–110 days) and low-input, highly useful oilseed crop. Although it is a temperate crop, by sowing in October it can be grown successfully with optimum yield in the tropics as well. *Camelina* is being grown as intercrop in *Jatropha* plantation for optimum utilization of land and for obtaining the most desired largescale feedstock for biodiesel production. Being a new biofuel crop in India, with 40% oil content, it will be of great significance for producing bio-diesel for defence use in fallow lands and also helpful in achieving the goal of the nation of 20% blending of commercial diesel with bio-diesel by 2017.

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RANJIT SINGH[1,*]
MOHD. NASIM[2]
S. TIWARI[1]

[1]*Defence Institute of Bio-Energy Research Project Site, Military Farm, Mhow 453 441, India*
[2]*Defence Institute of Bio-Energy Research, Haldwani 263 139, India*
**For correspondence.*
e-mail: sangwanranjit@rediffmail.com