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Research Article

EFFECT OF FRUIT MATURITY STAGES ON SEED QUALITY PARAMETERS IN JATROPHA *(JATROPHA CURCAS* L)

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ABSTRACT
Jatropha seeds extracted from fruits harvested at four stages of maturity i.e. green [approaching to maturity, 45 days after anthesis (DAA)], yellow (mature, 60 DAA), brown (ripened, 65DAA) and black (ripened and dried) were used for estimation of seed quality parameters. Fruits of Jatropha harvested at yellow colour stage recorded higher seed quality parameters viz., germination (91 %), mean seedling length (41.90 cm), mean seedling dry weight (363 mg), seedling vigor Index-I (3838) seedling vigor Index-II (33284), total dehydrogenase activity (1.72), protein content (24.64%) and with low electrical conductivity ($162dS^{-1}$ m). Therefore, harvesting of fruits at yellow stage would be better for seed purpose. However, fruits of black stage yielded higher seed oil per cent (43.75 %).

Key Words: *Jatropha, Seed Maturity, Seed Quality, Seed Oil, Seed Protein*

INTRODUCTION
Jatropha curcas belongs to the family Euphorbiaceae and believed to be originated from South America but introduced to India by the Portuguese. It is distributed throughout India especially in the dry tropical regions of the country. Of late, Jatropha received a lot of encouragement by the Government of India as a medium term alternative to energy security scheme in the country through the bio-diesel (Mukta and Sreevalli, 2007). *Jatropha curcas* is a quick maturing plant species that starts bearing fruits within a year of its planting. Jatropha is a monoecious shrub or small tree bearing trilocular fruits. Each fruit bears three black seeds, which are the source of oil. The species is perennial in nature and popularly called 'Physic nut' and it has assumed importance due to its short gestation period, drought endurance, low cost of seeds, high oil content, easy adaptation on marginal and sub-marginal lands; suitability as fuel substitute without any alteration to the existing engines, and above all the plant size that makes seed collection more convenient (Basha and Sujatha, 2007).

Further, seed maturity is a prime factor that decides the success of seed in further sowing. Fixation of optimum stage of physiological as well as harvestable maturity is very much necessary for production of better quality seeds. Seed maturation studies would help to know when the embryo become germinable and the seed attain maximum dry matter to reach physiological maturity that result in higher germination and vigour. The maturity stages have been found to induce changes in moisture percentage, physical and chemical properties of the seed during their growth and development. The rate of decline in vigour increases with increase in relative humidity, temperature and seed moisture once after seed reaches physiological maturity. The knowledge of seed maturation helps the seed grower to decide the time of harvest for sustaining highest quality in seeds and plan for post harvest operations like drying and processing. Jatropha crop is usually grown for oil purpose and is very important to determine the stage of maturity at which maximum percentage of oil can be attained besides its seed quality. Therefore, harvesting the seeds or fruit at the right time is very important to reduce considerable loss in quality. Therefore the present experiment was undertaken to know the effect of fruit maturity stages on seed quality of Jatropha.

MATERIALS AND METHODS

Fruits of different maturity stages were collected during *kharif* 2007 from the plots of "Jatropha germplasm" maintained by the department of Genetics and Plant Breeding at K-Block, GKVK, University of Agricultural Sciences, Bangalore. Twenty plants were randomly selected in the field and five to six inflorescences where tagged per plant. Number of days taken for fruit maturity was recorded from the day of anthesis to development of black layer on fruit. Fruits were harvested at different maturity stages *viz*., green [approaching to maturity, 45 days after anthesis (DAA)], yellow (mature, 60 DAA), brown (ripened, 65DAA) and black (ripened and dried) (Figure 1). Seeds were extracted from the fruits and dried to safe level of moisture (<9%). Then observations on seed quality parameters were recorded. Moisture content was estimated by low constant temperature method as per the procedure outlined by ISTA (2007). Seeds were tested for germination by adopting 'between paper' method at 25^0C. The germinated seedlings were evaluated on 10^{th} day of germination test. The total germination was expressed in per cent on the basis of number of normal seedlings obtained, mean seedling length was computed and expressed in centimeter. The mean seedling dry weight was recorded and expressed in milligrams per seedling. Seedling vigor index (SVI-I & II) was calculated by adopting the method suggested by Abdul-Baki and Anderson, (1973) and expressed in whole number. The electrical conductivity of seed leachate was determined as per procedure outlined by Tekrony, (2003) and expressed in dSm^{-1}. The pH of the seed leachate was measured by using digital pH meter (model 7007). The total dehydrogenase activity of the seeds was estimated as per the method described by Perl *et al*. (1978). Seeds collected at different maturity stages were used for oil extraction by using Soxtherm apparatus, with petroleum ether at 150^0C and expressed in per cent. The total soluble protein was estimated as per the method prescribed by Lowry *et al*. (1951). The experimental data were statistically analyzed as per the methods outlined by Sundararaj *et al*. (1972) adopting "Fisher's Analysis of Variance Techniques".

Figure 1: Different stages (Green-yelow-brown-black)of fruit maturity in *Jatropha curcas*

RESULTS AND DISCUSSION

Pod moisture content (%) differed significantly due to maturity stages and was higher at yellow stage (53.90 %) and was lowest at Black stage (11.44 %). In the present study, it was observed that as the maturity stage advanced from green to black, there was gradual reduction in pod moisture content. Similar findings were observed by Kalavathi (1996) and Kalavathi *et al.* (1998) in *Cassia angustifolia.*

Maturity stages differed significantly for germination per cent in first count and final count which was significantly higher at yellow stage (75.00 % and 91%) while the green stage recorded lowest germination (15.00 % and 35.00 %) (Table1) (Figure 2). This may be attributed to the physiological maturity of the seed at yellow stage. According to Harrington (1972) maximum seed quality is achieved towards the end of the filling period, when seeds reach maximum dry weight. Seed germination increased from green to yellow stage reaching maximum of 91 per cent. The germination per cent recorded was slightly lesser in brown (85%) and black (84%) stages. Similar results have been reported by Tekrony *et al.* (1981) and Obendorf *et al*. (1980) in soybean; Eeswara *et al.* (1998) in neem. Kaushik (2003) also reported maximum germination, when fruits are harvested at yellow stage in Jatropha.

Mean seedling length and mean seedling dry weight differed significantly due to fruit maturity stages, which were highest in yellow stage (41.90 cm; 363 mg) and lowest in green stage (32.60 cm: 186 mg). Kaushik *et al*., (2001) and Kaushik, (2003) had also reported reduced root and shoot lengths from seeds harvested at green stage.

Maturity stages significantly influenced the seedling vigor index -I which was higher at yellow stage (3838) and lowest at green stage (1149). Seedling vigor index -II differed significantly due to fruit maturity stages and it was higher at yellow stage (33284) while the green stage recorded lowest seedling vigor index-II (6703)(Table1). The vigour index of the seedlings raised from the seeds harvested in green stage was lowest. These findings are in agreement with Knittile and Burries, 1976.

Table1. Effect of maturity stages on seed moisture content, germination, mean seedling length, mean seedling dry weight and seedling vigor indices of Jatropha

Fruit Maturity Stages	Pod moisture content (%)	Germination (First Count) (%)	Germination (Final Count) (%)	Mean seedling length (cm)	Mean seedling dry weight (mg)	SVI-I	SVI-II
Green (45DAA)	52.49	15	35	32.60	186	1149	6703
Yellow (60DAA)	53.90	75	91	41.90	363	3838	33284
Brown (65DAA)	37.12	44	85	40.62	342	3463	29203
Black (70DAA)	11.44	64	84	38.77	319	3265	26948
S Em ±	0.12	1.33	1.74	0.58	10.11	92	944
C.D (0.05 P)	0.35	3.97	5.22	1.72	30.31	276	2840
C.V (%)	0.69	5.94	5.27	3.34	7.46	7.02	8.80

Note: DAA –Days After Anthesis, SVI- Seedling Vigour Index

Total dehydrogenase activity (absorbance at 480 nm) also differed significantly due to fruit maturity. It was higher at yellow stage (1.7184) and was lowest at green stage (1.4732). This is probably due to synthesis and accumulation of proteins at later part of maturity. Maturity stages strongly influenced the electrical conductivity of seed leachate which was significantly lower in the seeds obtained from yellow stage (162 dSm^{-1}) while seeds at green stage recorded higher EC (245 dSm^{-1}).

Figure 2: Germination of seeds harvested at different stages of fruit maturity in *Jatropha curcas* L.

However, the electrical conductivity was negatively correlated with the seed quality, lower EC at yellow stage is due to restoration of membrane integrity. The pH of seed leachate differed significantly due to maturity stages which was lowest at black stage (7.24) and was highest at green stage (8.50) (Table 2). Neutral pH was observed in all the stages except at green stage which recorded alkaline pH (8.50) due to leakage of more salts from the seeds at this stage.

Table 2: Effect of maturity stages on total dehydrogenase activity, electrical conductivity, pH, oil and protein in seeds of Jatropha

Fruit Maturity Stages	TDH (Absorbance at 480nm)	EC (dSm^{-1})	pH	Oil (%)	Protein (%)
Green (45DAA)	1.473	245	8.50	12.74	20.53
Yellow (60DAA)	1.718	162	7.96	30.27	24.64
Brown (65DAA)	1.690	185	7.80	36.83	23.44
Black (70DAA)	1.624	226	7.24	43.75	22.60
S Em ±	0.013	8.20	0.123	0.729	0.367
C.D (0.05 P)	0.039	24.59	0.370	2.187	1.099
C.V (%)	1.77	8.95	3.50	5.28	3.59

Note: DAA –Days After Anthesis, SVI- Seedling Vigour Index

The seed oil content also differed significantly due to fruit maturity stages, which was significantly higher at black stage (43.75 %) while the green stage recorded lowest oil content (12.74 %). The protein per cent also strongly influenced by the fruit maturity stages. Protein per cent was highest at yellow stage (24.64%) which was on par with brown stage. while lowest protein content was recorded at green stage (20.53 %). Oil content also increased significantly from 12.74 to 43.74 per cent as the maturity advanced

from green to black stage. But protein content was also higher (24.64%) at yellow stage and decreased slightly towards the end of maturity**.** Ravindrababu *et al*. (2006); Kathiravan (2006) and Kaushik *et al*. (2001) also opined that fruit maturity stages greatly influenced the seed oil and protein content in Jatropha.

Therefore, the findings of the study suggested that harvesting of fruits at yellow to brown stages was ideal for seed purpose. Further there was no need to wait until the black stage since it increases fruit loss due to dropping increase senescence due to weathering and results in loss of quality.

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