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Effect of mechanical seed scarification on germination and seedling growth of inter specific hybrids of oil palm (*Elaeis oleifera*)

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ABSTRACT

The mechanical scarification techniques were tried to break the seed dormancy of wild oil palm (*Elaeis oleifera* HBK) with an objective to get speedy, uniform germination and seedlings to facilitate precise evaluation of progenies of inter specific hybrids. The experiment was conducted using hybridized and freshly processed *Elaeis oleifera* seeds from Palm No. 6 planted during 1994. A total of six mechanical scarification techniques along with dry heat treatment were adopted to achieve the objective. The results revealed that chipping endocarp (removing round piece of endocarp containing germ pore) of the nut and de-operculum (removing plate like structure present in the seed coat above the embryo in the kernel) resulted in maximum germination with uniform seedlings production. Endocarp chipping combined with de-operculum resulted in maximum germination with 50% and took 3, 5 and 7 days to initiate germination, 50% germination and final germination (50%), respectively. Dry heated seeds took 15 days time to attain maximum germination (40%) after pre heating duration of 60 days in the heating room. One set of seeds which received hammer crack in nut germpore region remained dormant even after six weeks due to ineffective scarification. Hence, nut chipping and de-operculum technique is recommended to alleviate the dormancy and the successful treatment could be adopted for production of quality planting material in inter specific hybrid seeds.

Key words: Chipping, Seed dormancy, Speedy and uniform germination, Wild oil palm

The genus *Elaeis* consist two species namely, *Elaeis oleifera* HBK and *Elaeis guineensis* Jacq. The former one is called American oil palm or wild oil palm which is a wild relative of cultivated type and later is called African oil palm. Wild oil palm has low oil yield but it has several desirable characteristics, viz. slow vertical growth, disease resistance and best oil quality. A palm oil with a greater proportion of unsaturated fatty acids attracts new market opportunities for oil palm planters (Montoya *et al.* 2013). American oil palm is native to Central America and northern South America, is an important source of genetic variability for oil palm breeding. To sustain high yields, *E. oleifera* × *E. guineensis* (O×G) hybrids are backcrossed with *E. guineensis* and the progenies resulting from this breeding strategy presents variability. A selection cycle that includes evaluation, phenotypic selection, and crossing between the families selected to form a new population requires about 19 years (Wong and Bernardo 2008). The best hybrids are carried to next cycle. Protracted and delayed seed germination in wild palm improvement leads to non-availability of seedlings with uniform stages which affect breeding trials. The seed germination percentage obtained with *Ealeis oleifera* seeds following the dry heat method used for *E. guineensis*, have usually been low. Nunes *et al*. (1998) obtained approximately 30% germination in the interspecific hybrid seeds adopting dry heat treatments, whereas pure stand of *oleifera* gave 50% germination. With uneven growth of palms in the field, evaluation of progenies will be difficult. Major disadvantage in dry heat treatment is differences in seed germination among different cultivars with similar treatment period (Fondom *et al*. 2010). Therefore, a quick method of breaking dormancy is required to achieve uniform seedlings. Hence, in the present study, six mechanical scarification techniques were tried to break the seed dormancy with an objective to get uniform seed germination and seedlings with same age and vigour to facilitate precise evaluation of progenies of inter specific hybrids.

MATERIALS AND METHODS

Two Fresh Fruit Bunches (FFB) with uniform size produced by hybridisation and controlled pollination of selected *Elaeis oleifera* palm at Research Centre of Directorate of Oil Palm Research, Palode, Kerala, India were utilised for conducting this experiment. The experimental location has been receiving an annual rainfall of 2815 mm with an annual mean maximum, minimum temperature of 32.1°C and 22°C, respectively. It has forest laterite soil with a pH range of 5.0 to 5.5. The mesocarp of

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hybridised seeds was removed by mechanical de-pulper and extracted seeds were washed with detergent to clean mesocarp remnants. Seeds were also bleached by soaking in sodium hypochlorite (4%) (NaClO) solution for 15 minutes and surface dried in shade for two days by spreading on metal wire mesh trays as a single layer. The surface dried seeds of one of the hybridised bunches were subjected to grading and uniform seeds alone packed in polythene bag of 500 gauge thickness and dried in heating room maintained at 40° C for 60 days. After five days soaking, seeds repacked in poly bags and incubated in germination maintained at 25-27 ° C. Seeds from above heat treatment was used as control (T_7) and compared with new scarification techniques. Another hybridised bunch harvested and after seed processing similar to dry heat treatment was divided in to 6 groups and subjected to T_1, complete endocarp removal and de-operculum (Murugesan *et al*. 2008); T_2, chipping endocarp and de-operculum; T_3, chipping endocarp and scarification with pile rod; T_4, chipping endocarp and scarification with sand paper; T_5, chipping endocarp and needle insertion in operculum and T_6, making crack at germ pore region of shell using a hammer in such a way that kernel is not damaged while cracking the nuts. Chipping endocarp of the seed was done using chipping machine specifically developed along with electrically operated motor with cutting device for chipping the shell without damage to the shell for the treatments T_2, T_3, T_4 and T_5. Damaged seeds if any were rejected and substituted with undamaged ones. Similar to dry heat treatment, six treatments were incubated in germination room. All the seeds subjected to treatments T_1 to T_7 were soaked in water until they attained seed moisture content of 22% before scarification. The cross section of representative seed from each treatment was photographed using Canon camera model number EOS 6D with a magnification to 1:4 size to investigate changes occurring in the embryo, endosperm, operculum and interpretation with germination results. The photographs were taken two days after incubation in the germination room and significant changes occurred in the treatments were depicted in Fig 2.

The experimental design used was CRD with seven treatments each with three replications consisting 25 seeds per replication. The entire experimental set up was incubated in germination room maintained at room temperature (25-28° C). Germinated seeds were counted (when radicle protrudes) daily up to six weeks. Daily germination and cumulative germination were recorded and expressed as percentage. Days to 50% germination was calculated according to the formula of Coolbear *et al*. (1984). The results were subjected to an Analysis of Variance (ANOVA) to find out significant differences among scarification techniques (T_1 to T_5) and compared with treatment (T_7). The treatment T_6 was not included in the statistical analysis as there was no response of effect of treatments on seed germination. Healthy and vigourous germinated seeds of six scarification treatments and control were planted in the nursery with sufficient replications.

RESULTS AND DISCUSSION

Effect of mechanical seed scarification for speedy, uniform germination

The mean percentage germination recorded in treatments clearly indicates interspecific hybrids have poor germination capacity. However, there were highly significant germination responses observed among mechanical scarification techniques and dry heat treatments. The range of 23.3 to 50% was recorded in endocarp removal and scarification with corrugated rod (T_3) and endocarp removal and de-operculation (T_2), respectively. Maximum seed germination (50%) was recorded in the case of chipping and de-operculion (T_2) followed by complete endocarp removal and de-operculation (T_1: 43.33%) (Table 1). Initiation of seed germination was observed 3 days after

Table 1 Effect of mechanical scarification treatments on seed germination in interspecific hybrids of wild oil palm (*Elaeis oleifera,* HBK)

Treatment *	Days to 50% germination	Days to maximum germination	Final germination after six weeks(%)	SE Final germination (%)
T 1: Complete endocarp removal and de-operculum	5.00	7.00	42.50	2.50
T 2: Chipping endocarp (removing round piece of endocarp containing germ pore) and de-operculum	4.00	6.00	50.00	4.08
T 3: Chipping endocarp and scarification of operculum with pile rod	4.00	6.00	22.50	2.50
T 4: Chipping endocarp and scarification of operculum with sand paper	5.00	6.00	30.00	0.00
T 5: Chipping endocarp and needle insertion in the operculum	4.00	6.00	35.00	2.89
T 7: Dry heat method	13.00	15.00	40.00	
CD	1.283	1.283	7.347	
SE(m)	0.422	0.422	2.415	
SE(d)	0.596	0.596	3.416	
CV	14.456	10.999	13.174	

*T 6 was not included in the statistical analysis as there was no response observed to treatment

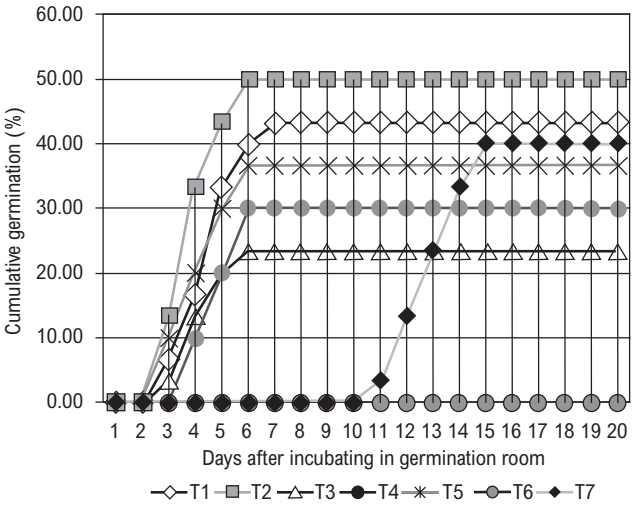

Fig 1 Cumulative germination percentage of wild oil palm seeds subjected to different mechanical scarification and dry heat techniques. T1: Complete endocarp removal and de-operculum, T2: chipping endocarp (removing round piece of endocarp containing germ pore) and de-operculum, T3: chipping endocarp and scarification of operculum with pile rod, T4: chipping endocarp and scarification of operculum with sand paper, T5: chipping endocarp and needle insertion in the operculum, T6: making crack at germ pore region of shell and T7: dry heat method.

incubation in the germination room in all the scarification treatments which is in agreement with report by Murugesan, (2008) in de-operculated oil palm seeds, where embryos commenced elongation after 2- 4 days at 30ºC, whereas intact seeds failed to germinate. All the scarification treatments except T_6 reached 50% germination within 4-5 days, whereas, dry heat treatment took 13 days. There was no much difference in the case of total germination as all the scarified seeds (except T_6) reached maximum germination within 6-7 days. Dry heated seeds (T_7) took 15 days time to complete germination. Main disadvantage observed was that the time needed to reach maximum germination 50 % level in the case of dry heat treatment (T_7) was 75 days (60 days for heating and 15 days to complete germination excluding the period of 10 days (5 days for water soaking before heating and 5 days prior to incubation in germination room) whereas, it was only 6 days in the case of scarification treatments especially T_2 which resulted in maximum germination when compared to others. In case of T_2, radicle protrusion seen even after two days incubation as observed in the Fig 2a. Though, heat treatment (T_7) was equally effective and third among treatments with 40% germination, it consumed extra two months heating in heating room while germination commenced 15 days after incubation in germination room. Fig 2c clearly showed that fibre plug and plate like structure are tightly intact and embryo protrusion not seen after two days incubation in the germination room. Variation in the physical properties of seeds has been reported in oil palm hybrid seeds within single bunch (Murugesan *et al*. 2010) which may require differential thermal requirement for breaking dormancy and germination responses in the conventional method (Dry heat technique). One set of seed which received hammer crack in germpore region remained dormant even after six weeks. In this case, dormancy barriers such as plate like structure, endosperm above the embryo might not have been affected due to the treatment (Fig 2b). Seed shell thickness and shell weight did not relate with germination (Myint *et al*. 2010). The shell may not be involved in seed germination in spite of the fact that one of the physical barriers that are fibre plug is present in the shell and cracking the shell in the germ pore region may not cause desired effect to facilitate germination. Therefore, it is certain that heat technique takes longer duration to break dormancy when compared to other techniques.

Speedy and uniform germination in mechanical scarification technique

Endocarp chipping combined with de-operculation resulted in maximum germination (50%) and took 3, 5 and 7 days to initiate germination, 50% germination and final germination, respectively. The treatments namely T_3, T_4 and T_5 resulted in slower 23.3, 30 and 36.67 percent of germination, respectively when compared to T_2 (Fig 1). Since germination achieved in T_2 was significantly greater than the other treatments, chipping combined with de-

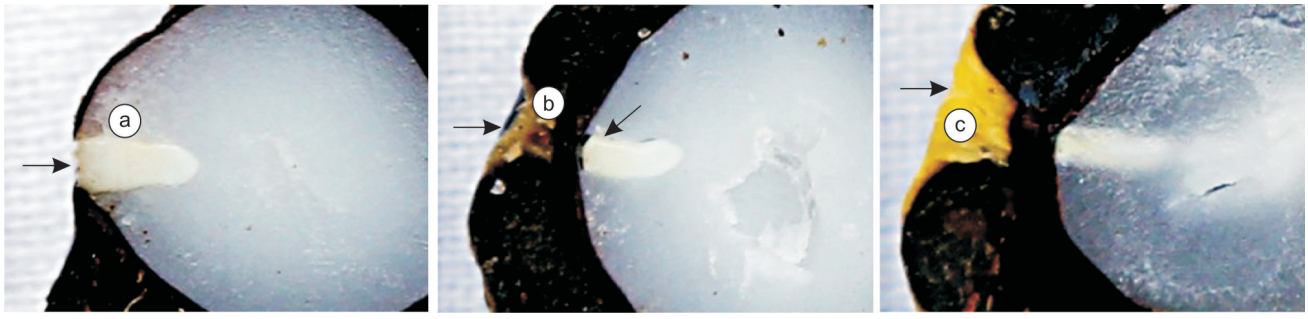

Fig 2 View of cross section of micropylar region of the interspecific hybrid seed subjected to mechanical scarification treatments (Treatments with significant changes in the critical structures alone given). a (T_2): Chipping endocarp and de-operculation (radicle protrusion seen after 2 days after incubation), b (T_6): Making crack at germ pore region of shell of the nut (no embryo growth is observed after 2 days incubation and crack in fibre plug and gap above the embryo are seen), c (T_7): Dry heat method (operculum is prominently present and embryo is intact and no embryo growth initiated).

operculation can be profitably adopted for production of uniform seedlings. In seed production centres, some hybrid combinations showed embryo abnormality due to incomplete development of embryo during fruit development which results in abnormal germinated seeds. It has been reported by Corley and Tinker (2003) that there is relationship between embryo abnormality and germination efficiently and seedling development. In this context, early detection of abnormal sprouts is possible through chipping and de-operculation method and we can carry forward only normal and healthier ones in the nursery, whereas dry heat process takes longer duration. Since, the time to completion of germination in a given batch of seeds is very short (7 days) the production of uniform seedlings is assured.

Effect of treatments on seedling growth in primary nursery

Healthy, vigorous germinated seeds of all the treatments of dormancy breaking treatments except T_6 (where no germinated seeds obtained) were planted in the nursery showed no significant difference for seedling growth parameters at three months after planting while all the seedlings exhibited normal growth under standard nursery management practices.

CONCLUSION

Since germination achieved in T_2 significantly greater than the other treatments, chipping combined with de-operculation technique could be adopted for production of uniform seedlings of inter specific hybrids of wild oil palm.

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