

RESEARCH ARTICLE

Effects of Pod Maturity Phases on Physical Dormancy Induction in Silk Tree (*Albizia julibrissin* Durazz) Seeds

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ABSTRACT

The study examined the effect of the pod colors as an index of maturity phases on seed traits of silk tree (*Albizia julibrissin* Durazz). Silk tree pods were simultaneously collected at five maturity phases based on pods color in late September in the Hyrcanian plain forest, Tashbandan-Iran. Seeds were removed from pods and seed moisture content (MC), 1000 seed weight (1000 SW) and germination performance were determined. Maturity phases affected seed MC and 1000 SW. MC and 1000 SW were the highest at the pod color of full green (61% and 64.2 g, respectively). As the seeds matured, MC and 1000 SW decreased, and the lowest MC and 1000 SW were found as 8.5% and 36.2 g, respectively at seeds harvested at the dark brown stage. Germination percentage (GP), germination speed (GS) and mean germination time (MGT) were significantly affected by seed maturity phases, and GP and GS were the lowest in the dark brown pod stage (6% and 0.2, respectively). GP and GS was the highest at seeds harvested at the half green-half brown stage. MGT was increased to the maximum when seeds were harvested at the dark brown pod stage (29.8). This study showed that when pods have reached maturity, the coats of the seeds have no barrier to germination but as ripening continues, germination of silk seeds were hindered by impervious seed coats that retard the entry of water. The study revealed that pod color could be used as an indicator for physical dormancy level of silk tree seeds.


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1. Introduction

Silk tree (*Albizia julibrissin* Durazz) is a species of Fabaceae family which widely distributed in Asia, Africa, Australia and the tropical and subtropical America (Zheng et al., 2004; Kim et al., 2007). Its blooms that resulted in pods open from early July to mid-September. Because of this long flowering period, seeds in various stages of development are found at the time of collection (Fordham, 1968). The pods from early flowers are plump and ripe while others from late his called physical dormancy (PY), and it develops during maturation drying of seed (Van Staden et al., 1989; Baskin & Baskin, 2014). Seed moisture content decreased significantly with increasing maturity (Bhupendra et al., 2008). Maturation drying i.e. loss of moisture during the final stages of seed or

fruit development due to abscission of the maternal vascular supply, plays a major role in acquisition of PY (Qu et al., 2010). During this stage, the moisture content of seeds/fruit decreases rapidly and once it reaches a certain level that varies from aprox. 5 to 20% among species, the seed or fruit can become water impermeable (Li et al., 1999; Jayasuriya et al., 2007; Qu et al., 2010). Earlier studies on seed maturity levels affecting on germination by Khera et al. (2000), Virendra et al. (2005), and Seth and Agrawal (2003) revealed that seed maturity significantly influence on germination. Many factors such as stage of seed development or maturity when drying starts (Aitken, 1939; Samarah et al., 2003; Samarah, 2005, 2007) help determine the proportion of seeds in a given seed crop that develops impermeable coats. The most commonly used indices

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of fruit or seed maturity are based on physical characteristics. The hard seed coat which is responsible for delayed germination in various legume seeds (Bhupendra et al., 2008) have a water-impermeable palisade layer (Rolston, 1978; Bianco & Kraus, 2005). Previous studies showed that germination of *Albizia* seeds is hindered by impervious seed coats that retard the entry of water, and the seeds of *Albizia julibrissin*, required scarification or soaking in water for germination (Moore & Moore, 1962; Gogue & Emino 1979; Parrotta, 1987; Francis & Rodríguez, 1993; Parrotta et al., 2008; Azad et al., 2012). Change of fruit color is widely used on both dry and fleshy fruits. The most common color changes are from a “vegetative green” to a shade of brown in dry fruits (Bonner, 2008). McDonald et al. (2000) remarked that changes in seed color or other visual changes in seed or fruit structure are also excellent morphological indicators of physiological maturity. The objectives of the present study were to determine the effect of the pod colors as an index of maturity phases on germination, moisture content and 1000 seed weight of silk tree seeds.

2. Materials and Methods

The pods of Silk tree were collected of different physiological maturity phases at the same time (Late-September) from at least 10 tree in Mazandaran province in the North of Iran, Tashbandan forests (617171.1 E and 4046703.97 N). The pod colors as an index of maturity phases were selected as follows: full green (1) half green-half brown (2), greenish-brown (3), light brown (4), and dark brown (5). Physical traits (MC, 1000 SW) of extracted seeds were determined. Then seeds were sown in four replicates of hundreds in sterilized sand and put in germinator (22 °C). Germinated seeds were counted and removed after every 2 days recording. Germination traits such as germination percentage (GP), germination speed (GS) (Willan, 1985; Panwar & Bhardwaj, 2005), and mean

germination time (MGT) (Younsheng & Szikaie, 1985; Bewley & Black, 1994; Falleri et al., 1997) were calculated as follows:

$$GP = \Sigma n/N \times 100 \quad (1)$$

$$GS = \Sigma (n/DSS) \quad (2)$$

$$MGT = \Sigma (n_i \cdot t_i) \cdot n_{total}^{-1} \quad (3)$$

Where:

n = number of germinated seeds in each count

N = number of sown seeds

DSS = days from the start of the test

n_i = number of seeds germinated in a specific day (t_i)

n_{total} = the total number of germinated seeds

All of analytical testing was done according to ISTA (2008) rules. All tests were done according to completely randomized design. The data were subjected to ANOVA to determine the significance level and mean differences calculated by Duncan's new multiple range test.

3. Results

The analysis of variance revealed that there are significant differences among all maturity phases in physical (MC, 1000 SW) and physiological traits (GP, GS, MGT) ($P < 0.01$) of silk tree seeds (Table 1). According to the results of Duncan's test; Moisture content and 1000 SW continuously reduced from 61, 59, 55, 21, to 8.5% and from 64.2, 63.4, 54.4, 43.5 to 36.2 g respectively (Figure 1). GP and GS showed similar variation during maturity phases. They increased during the first maturity phases and then decreased markedly at the end ones. GP started at 75, 95, 94, and 80 and finally reduced to 6% (Figure 2a). GS rated from 11.3, 15.5, 12, 11 to 0.2 (Figure 2b). MGT constantly increased at the first phases (6.9, 6.8, 7.7, 8.2 days) but a severe increase happened in the last phase (29.8 day) (Figure 2c).

Table 1. The lab analysis results of five maturity phases.

Maturity phases	Physical traits		Physiological traits			
	MC	1000 SW	Germ. initiation	GP	GS	MGT
Full green (1)	61 ^a	64.2 ^a	2	75 ^c	11.3 ^c	6.9 ^d
Half green-half brown (2)	59 ^b	63.4 ^b	2	95 ^a	15.5 ^a	6.8 ^d
Greenish-brown (3)	55 ^c	54.4 ^c	2	94 ^a	12 ^b	7.7 ^c
Light brown (4)	21 ^d	43.5 ^d	2	80 ^b	11 ^c	8.2 ^b
Dark brown (5)	8.5 ^e	36.2 ^e	23	6 ^d	0.2 ^d	29.8 ^a
<i>F</i>	3296.000	8047.000		835.082	790.000	6041.000
<i>Sig.</i>	0.000	0.000		0.000	0.000	0.000

Note: Each letter represents the homogeneous group formed by multiple test analysis.

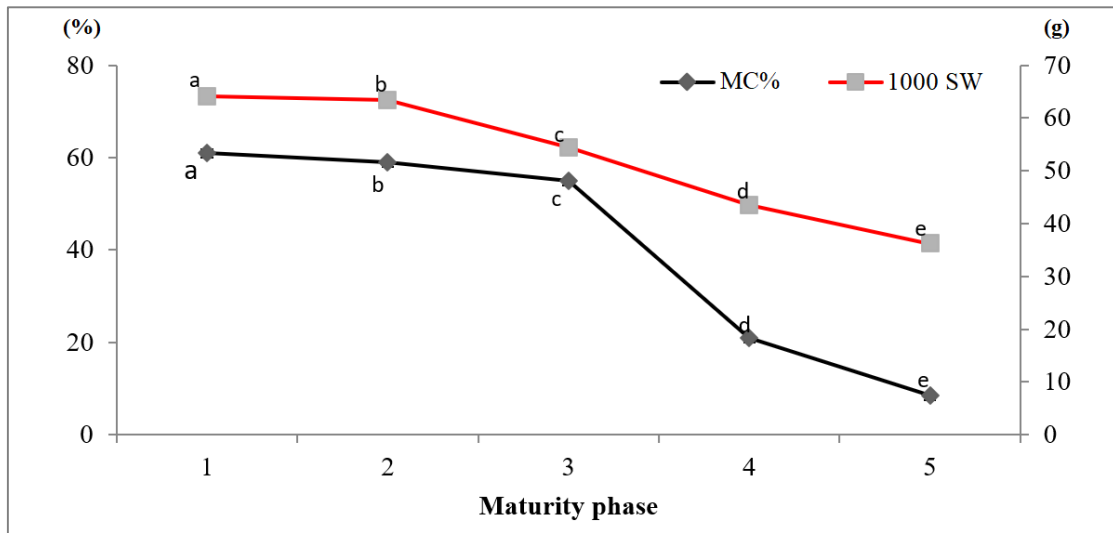


Figure 1. Differences in MC and 1000 SW (g) among maturity phases.

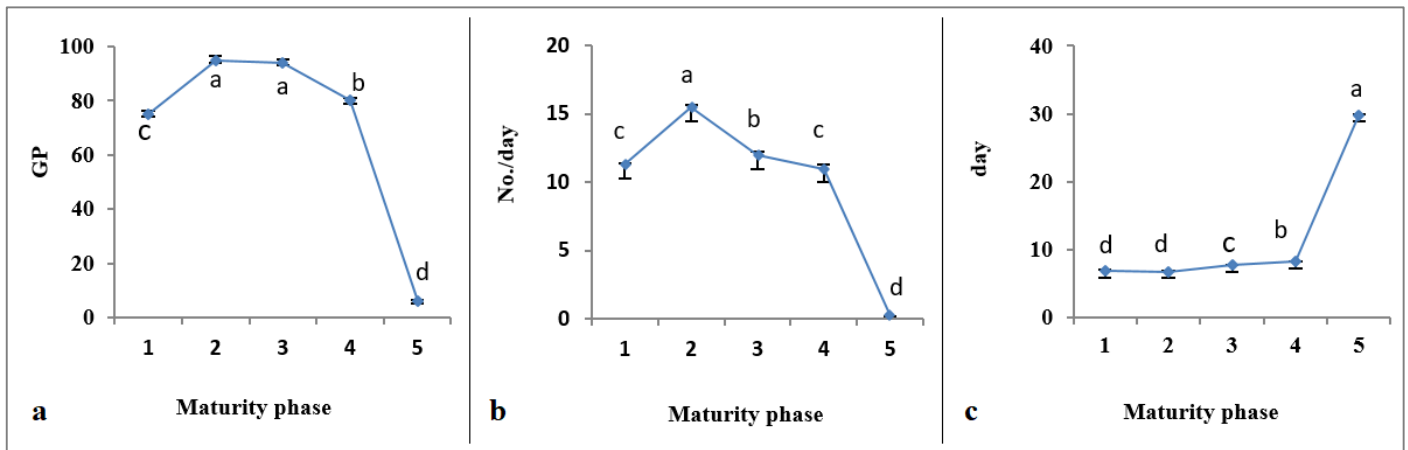


Figure 2. Duncan test results differences in germination traits (a: Differences in GP among maturity phases, b: Differences in GS among maturity phases, c: Differences in MGT among maturity phases).

4. Discussion and Conclusion

Present study revealed that silk tree seed traits were greatly affected by pods maturity phases. Seeds gradually undergo to deep physical dormancy by changing seed MC (61% to 8.5%) and pod color (green to dark brown). Results showed that seed germination traits increased (except MGT) during early stages of ripening (except for the first maturity phase that probably was not completely ripened) and decreased in last maturity phase because time of seed collection or on the other hand seed maturity levels significantly affect the germination as stated by Seth and Agrawal (2003), Khera et al. (2000), and Virendra et al. (2005). Although in our study all seed maturity phases were simultaneously on silk trees. Results also showed that seed moisture content decreased significantly with increasing maturity (Bhupendra et al., 2008). Qu et al. (2010) also indicated that loss of moisture during the final stages of seed or fruit development plays a major role in seed coat hardness and acquisition of PY. This study also showed that changes of physical characteristics such as fruit color from green to brown

in dry fruits (Bonner, 2008) or other visual changes in seed or fruit structure are excellent morphological indicators of physiological maturity (McDonald et al., 2000). We also found that MC decreasing resulted in seed coat hardness and physical dormancy in Silk tree seeds is responsible for delayed germination (Bhupendra et al., 2008) and this acquired in dark brown (phase No 5) with MC of 8.5%. It can be concluded that pod and seed maturity levels affect germination traits and physical dormancy depth of silk tree seeds. As ripening continues, the seeds have water impermeable coats. Thus, germination of Silk tree seeds was hindered by impervious seed coats that retard the entry of water. If seeds (or fruits) that are capable of developing impermeable coats are collected at the time of embryo maturity but before any drying occurs, many of them will germinate (Baskin & Baskin, 2014). Finally, the study showed that silk tree pods can be collected in phase (phases No. 2, 3, and 4) that seeds either has been physiologically ripened or don't undergo dormancy to need any treatment.

Conflict of Interest

The authors declare that they have no conflict of interest.

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