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PROPAGATION METHODS OF SOME PAWPAW GENOTYPES [*ASIMINA TRILOBA* (L.) DUNAL]

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Abstract

The paper presents the effectiveness of various propagation methods applied to several pawpaw (Asimina triloba (L.) Dunal) genotypes. Generative propagation, propagation by grafting, and by cutting have been studied. Various generative propagation methods as seeds exposure to polarized light and different magnetic fields before sowing and to LED light, throughout the germination period have been tested. The grafting was performed at different times of the year (spring and autumn) on one-year-old rootstock. Following the conducted research, it was concluded that the most effective propagation methods were seed propagation and grafting, while propagation through cuttings was inefficient. By subjecting the seeds to magnetic fields and LED light before sowing, the germination period was significantly reduced, and their germination capacity increased. The most optimal period for grafting was early spring, after the rootstocks started the vegetative growth.

Key words: *generative propagation, grafting, LED light, magnetic field.*

INTRODUCTION

Asimina triloba (L.) Dunal has been known by various names over the years, such as Indian banana, poor man's banana, northern banana, but the most commonly used name has been pawpaw (Moore, 2015). Originated from the eastern region of the United States (Layne, 1996), pawpaw was introduced in Romania in 1926 by the Suciu family. They brought from USA in Pianu de Sus, Alba County few pawpaw fruits (Stănică, 2012). In 1996-1997, the first pawpaw plants were planted in the didactic-experimental field of the Faculty of Horticulture within University of Agronomic Sciences and Veterinary Medicine of Bucharest (Cepoiu et al., 2004). From a botanical standpoint, it is classified in the *Annonaceae* family, one of the ten families included in the *Magnoliales* order (Kral, 1960; Callaway, 1992).

The fruit is characterized by two rows of sizable, brown, bean-shaped seeds that are laterally compressed, reaching lengths of up to 3 cm in length and 1.5 cm in width (Layne, 1996; Geneve, 2003). Alkaloids with emetic properties are present in the seeds endosperm (Vines, 1960). Chewing the seeds could potentially disrupt mammalian digestion due to the presence of toxic substances. However, if swallowed whole, the seeds can safely traverse the digestive tract without harm (Layne, 1996).

Once the flesh becomes soft, the fruit can be harvest for seed extraction. Following the maceration of the fruit in water, the seeds can be easily extracted as the pulp floats away (Layne, 1996). Mature pawpaw seeds, immediately extracted from fleshy fruits, contain approximately 37% moisture. This value remains relatively stable even if seeds are imbibed. Viability decreases by 50% when seeds are dried from their initial 37% to 25% moisture, with total loss occurring between 15% and 5% moisture (Geneve et al., 2003). For long-term storage and viability retention, pawpaw seeds must be stored moist at chilling temperatures [5°C (41.0°F)] (Finneseth et al., 1998). Finneseth et al. (1998) established that approximately seven weeks of chilling stratification at 5°C were necessary to achieve 50% germination. The highest germination percentages, ranging from 84% to 90%, were observed after approximately 100 days of stratification (Geneve et al., 2003; Pomper et al., 2003).

Figure 1. Pawpaw seeds

The seeds need to planted at approximately 2.5 cm deep. Once seedlings reach a height of 10 to 20 cm, they can be transplanted into tall pots (10 x 10 x 36 cm) with partially open bottoms, positioned on greenhouse benches to allow taproots to be "air-pruned" (Callaway, 1993).
Grafting is a surgical operation that involves joining two partners, one represented by a bud or graft branch, and the other represented by a rooted cutting, a seedling, or a *in vitro* multiplied plant (Ghena, 2004).
The most dependable and widely employed technique for vegetative propagation is chip-budding (Callaway, 1993; Stănică, 2004). The potential to propagate pawpaw cultivars through cuttings offers several benefits compared to seed-based or grafting approaches. Plants derived from cuttings would bloom earlier than those from seeds, and cuttings would address issues related to understock suckering observed in grafted plants (Geneve, 2003).

MATERIALS AND MOTHODS

The experiment location was the didactic-experimental field, the greenhouse and the vegetation house of the Faculty of Horticulture, University of Agronomic Science and Veterinary Medicine of Bucharest.
The biological material was collected from the pawpaw trees grown in the experimental field of the Faculty of Horticulture and it consisted of branches and seeds sampled from:

- 16 cultivars – Simina, Allegheny, Artemis (MJ), Shenandoah, Wabash, Asteria (250-30), Rebecca S.G., Sweet Alice, Sibley, Saa Zim, Sunglo, Prima 1216, Overleese, Ithaca, Sunflower, Davis;
- 17 hybrid genotypes – R1P1, R1P2, R1P3, R1P4, R1P5, R1P6, R1P7, R1P8, R1P9, R1P10, R2P1, R2P4, R2P6, R2P7, R2P8, R2P9, R2P11;
- 16 new hybrids – R0P11, R0P13, R0P14, R0P17, R0P18, R0P21, R0P22, R0P24, R0P25, R0P26, R0P33, R0P35, R0P37, R0P39, R0P42, R0P64.

Generative propagation, propagation by grafting, and by cutting have been attempted.
Generative propagation – three different methods were tried to stimulate the seeds germination rate:

- exposure to LED light;
- treatment with polarized light;
- treatment with magnetic field.

All seeds were sowing at the end of February in multicell trays, in a substrate composed of peat (70%) and perlite (30%) at a constant temperature of 21°C in the greenhouse.
For control and the LED light variant, all the cultivars, genotypes and hybrids were used. The seeds were exposed to LED light throughout their germination period.
In the second experiment, seeds collected from six genotypes (R1P10, R2P1, R2P4, R2P6, R2P9, R2P11) and two cultivars (Simina and Allegheny) were exposed before being sown for 5, 15 and 30 minutes to polarized light. The equipment used for conducting this research was a Bioptron PRO 1 biolamp with a fullerene filter.
For the third experiment, two genotypes (R2P9, R2P11) and two cultivars (Simina and Allegheny) were exposed before being sown for 5, 15 and 30 minutes to magnetic field with positive pole and negative pole.
Propagation by grafting – was done by chip-budding on one year old seedlings, in two different periods: spring – April and autumn – September.
Propagation by cutting – the cuttings were placed for rooting in perlite in June.

RESULTS AND DISCUSSIONS

Generative propagation is widely used because pawpaw seeds have a good or even very good germination capacity depending on the cultivar.

To determine the germination capacity of pawpaw seeds according to the cultivar, the entire evolution period of the seeds was monitored, from the time of sowing until the end of germination. The following results were observed (Figure 2):

- All studied cultivars or genotypes had a germination capacity of over 70%;
- The highest seed germination capacity of, with a percentage of 100%, was recorded in the cultivars Rebecca S.G., Sweet Alice, Sibley, and Davis, as well as in R0P18, R0P33, R0P37, R0P42, and R0P64 hybrids;
- The lowest seed germination capacity was found in the cultivars Shenandoah and Sunglo, with a percentage of 70%.

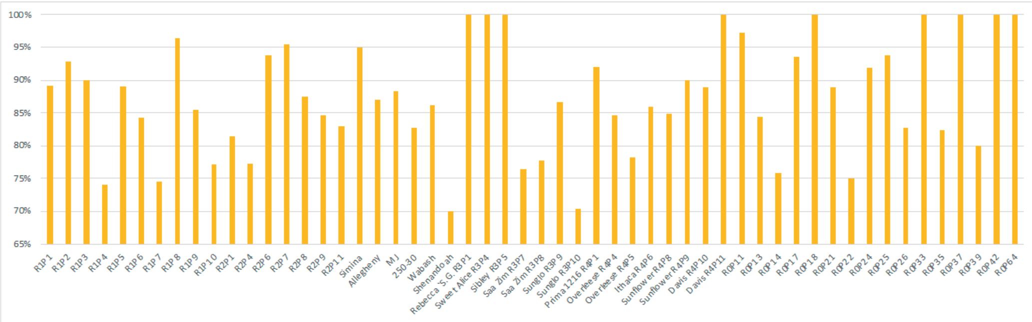

Figure 2. Germination percentage of pawpaw seeds

To observe if LED light influences the seed germination process, several aspects were monitored.

The first, was the tracking of germination and seedling emergence period both in the normal system and under the influence of LED light. Following this experiment, it was observed that LED light helps expedite the seed germination process and simultaneously

reduces the germination spread period. Seeds sown in the normal system generally require a germination period of approximately 6-7 weeks, which can be even longer. For instance, cultivars like Sweet Alice and Saa Zim started to sprout after a period of 9 weeks, while it can be shorter, for R2P1 and 250-30 genotypes (4 weeks). Seeds exposed to LED light generally require a germination period of about 4-5 weeks. For example, R0P33 and R0P35 hybrids sprouted after 6 weeks, Wabash and 250-30 cultivars, sprouted after only 4 weeks.

The second studied aspect was the monitoring the duration period of seedling emergence. It was also observed a reduction of this period by approximately one or even two weeks in seeds exposed to LED light compared to the control seeds. The greatest difference recorded was in genotypes R1P1, R1P5, and R1P9, and cultivar Saa Zim, with a two-week reduction, while the smallest difference was in genotype 250-30, where control seeds sprouted 5 days faster compared to those under LED light.

Figure 3. LED light exposure

Furthermore, the percentage of seed germination was also monitored for those developed under LED light compared to those developed in the normal system. Following this study, it was observed that LED light does not affect the germination percentage, with the number of sprouted plants being similar on both sides or, in many cases, even higher for plants grown in the normal system.

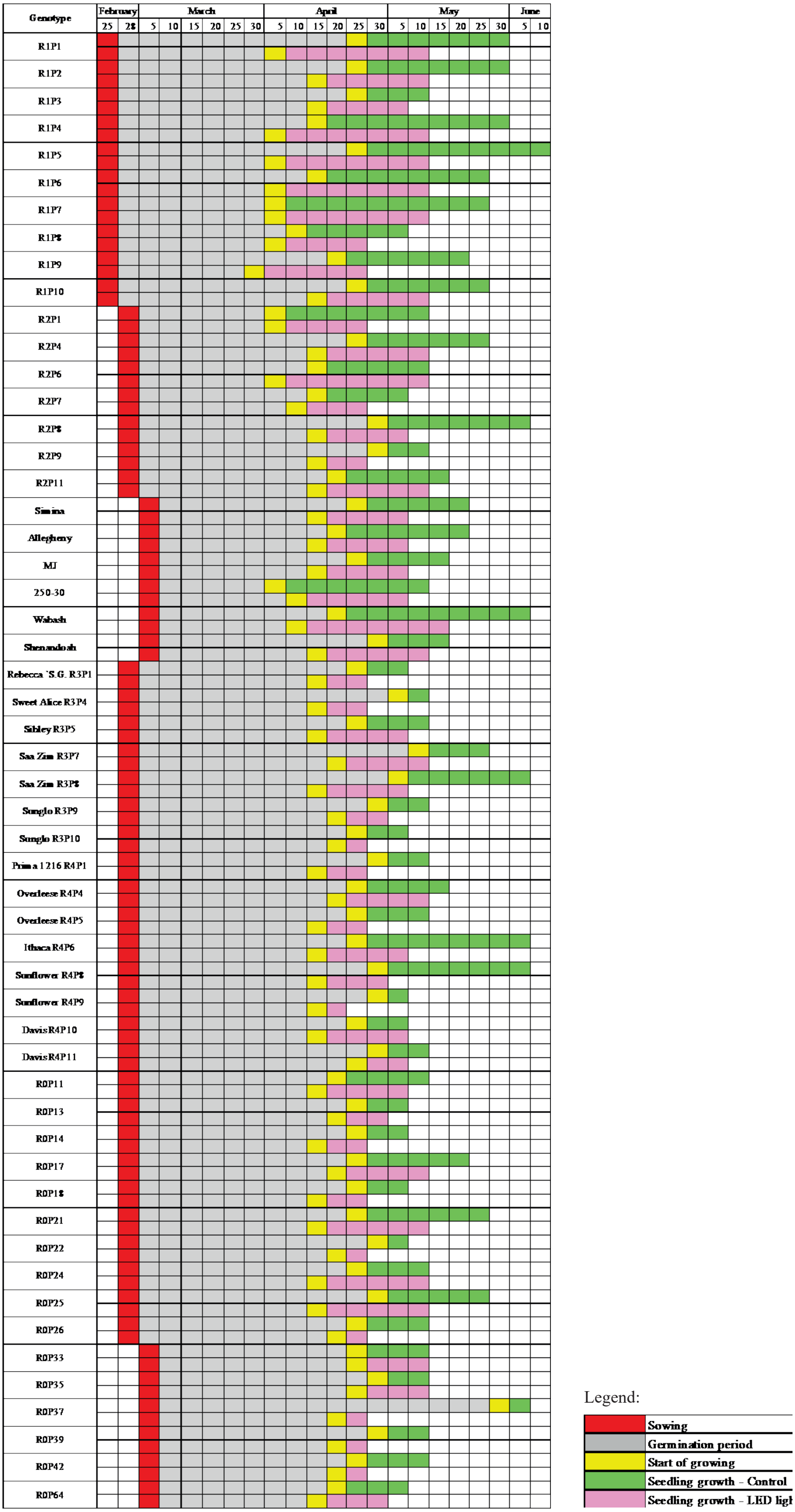

Figure 4. Influence of LED light on pawpaw seeds germination

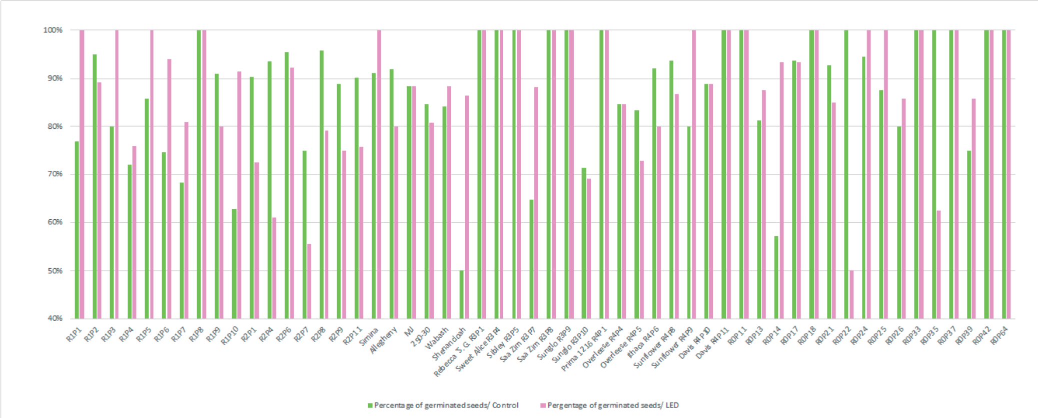

Figure 5. Influence of LED light on pawpaw seeds germination percentage (%)

To observe whether polarized light influences the seed germination process, a study was conducted on 6 genotypes (R1P10, R2P1, R2P4, R2P6, R2P9, R2P11) and 2 varieties (Simina and Allegheny) for which various aspects were monitored.

The first aspect was the monitoring of germination and seedling emergence period. Following this experiment, it was observed, that polarized light does not influence the acceleration of the seed germination process or the reduction of the germination spread period with an exposure of only 5-30 minutes.

The percentage of seed germination was also monitored for seeds that were previously exposed to polarized light. Following this study, it was observed that polarized light does not affect the percentage of seed germination, which is moderate or even low.

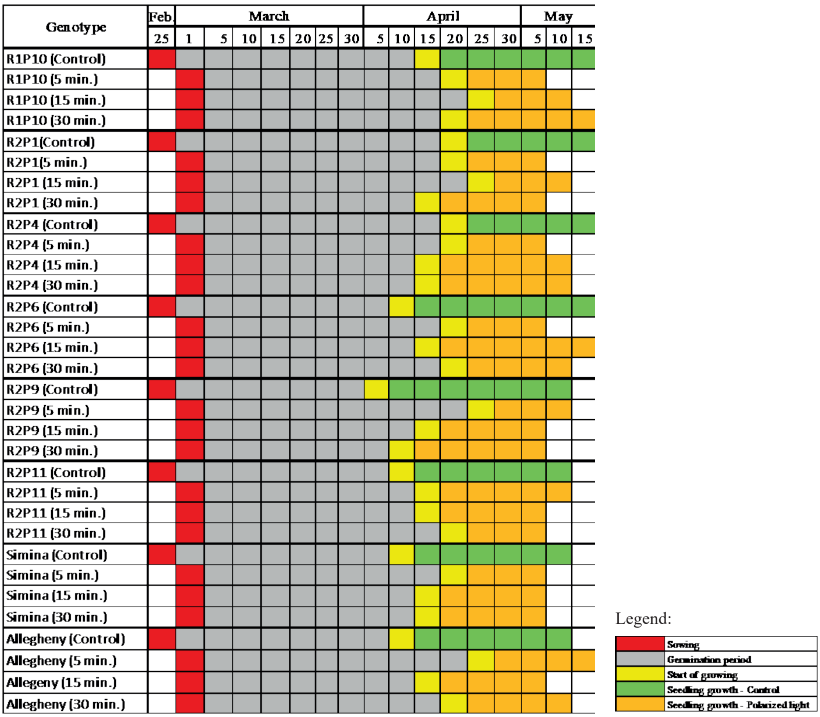

Figure 6. Influence of polarized light on pawpaw seeds germination duration

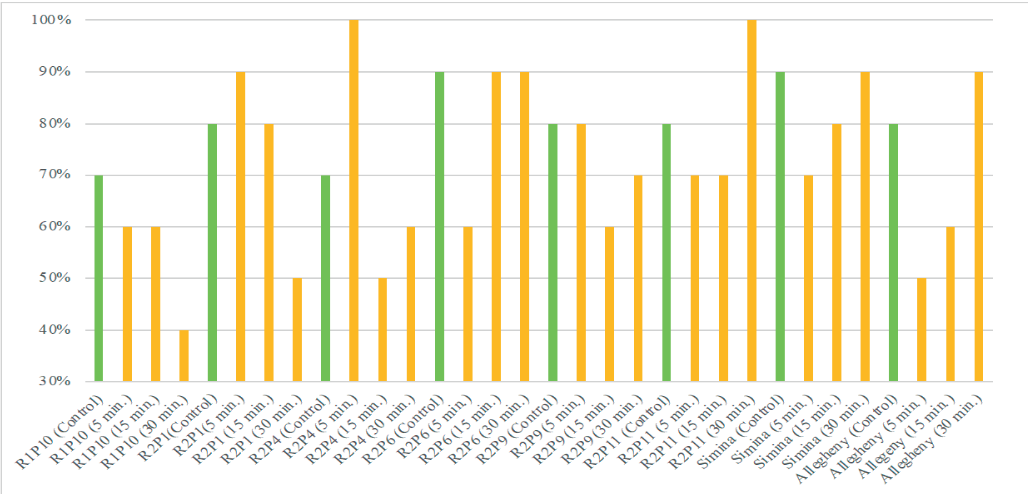

Figure 7. Influence of polarized light on pawpaw seeds germination percentage (%)

To observe if the magnetic field influences the seed germination process, a study was conducted on 2 genotypes (R2P9, R2P11) and 2 varieties (Simina and Allegheny), for which multiple aspects were monitored.

The first involved aspect was monitoring the seeds germination period and the emergence of seedlings. It was observed that the pre-exposure to magnetic fields helps to accelerate the seed germination process and also reduces the germination duration. Shortening of the germination period was recorded for all genotypes, but the best results were obtained with genotype R2P11, where the germination period was reduced by 2 weeks.

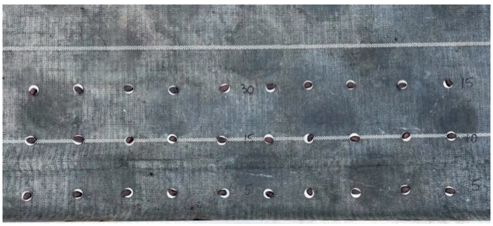

Figure 8. Seeds subjected to magnetic fields

The germination percentage of seeds exposed to magnetic fields was also monitored. Following this study, it was observed that the seed germination rate is positively influenced by exposure to magnetic fields, reaching over 80%.

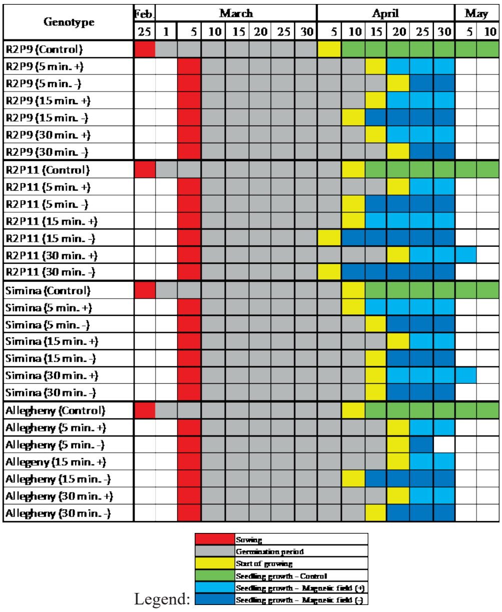

Figure 9. Influence of polarized light on pawpaw seeds germination

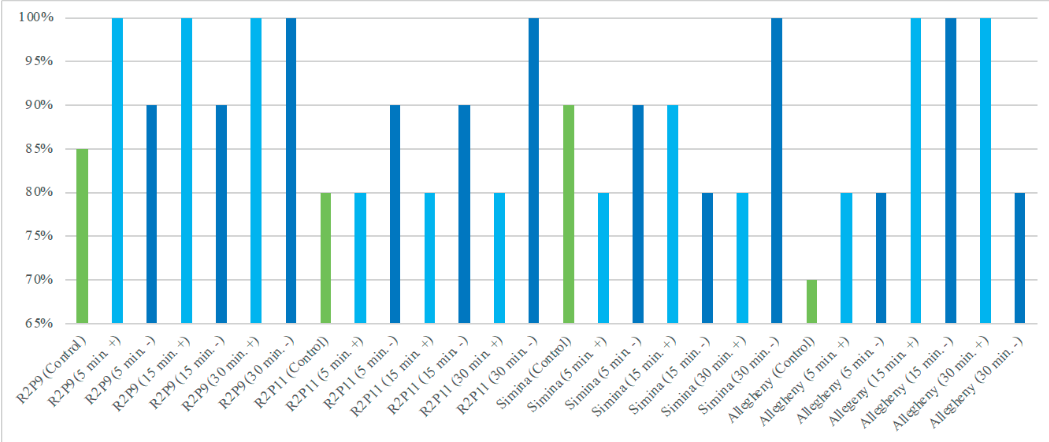

Figure 10. Influence of magnetic field on pawpaw seeds germination percentage (%)

Propagation by chip budding was attempted in two different periods of the year – spring and autumn.

Chip budding in autumn was carried out in September 2022, and the grafts' success rate was very low, below 10%.

The grafting was attempted again in the spring of 2023, on the same rootstocks. This time a good success rate was obtained.

The lowest chip budding success rate was encountered in the Rebecca 'S.G.' variety, at 65%, while the highest success rate of 100% was found in R2P1 and R2P11 genotypes, as well as in Saa Zim, PA Golden, and Sweet Alice varieties.

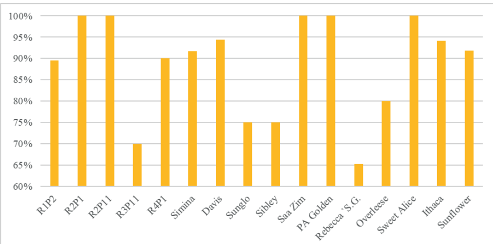

Figure 11. Chip budding success (%) in spring 2023

Propagating by cuttings was inefficient in the case of Simina. The substrate used was perlite and peat with sand, and bio-rooting hormones were used to stimulate root formation. No rooting was registered.

CONCLUSIONS

Following the research conducted on *Asimina triloba* (L.) Dunal propagation methods, several conclusions were drawn:

From the various propagation methods tested, it was concluded that the most efficient methods are seed propagation and chip budding, with few mentions.

Seed propagation can be stimulated through various methods, but from those addressed in this research, the highest score was recorded when seeds were pre-exposed to magnetic fields before sowing and to LED light throughout the germination period. It is noteworthy that LED light stimulates the speed of seed germination and reduces the duration period of seedling emergence but does not influence germination capacity. Pre-exposure to a magnetic field, on the other hand, stimulates both the speed of seed germination and reduces the duration period of seedling emergence and positively influences the seeds germination capacity. Pre-exposure to polarized light does not affects their productivity.

Based on the conducted study, it is evident that grafting/chip budding represents the best vegetative propagation method for pawpaw due to the good success rate. It is worth mentioning that chip budding done in the fall was not effective.

Regarding cutting propagation through, it was concluded that pawpaw does not exhibit rooting capacity.

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