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A SCARIFICATION METHOD WITH A HOUSEHOLD MIXER FOR KUDZU SEED (*Pueraria lobata* Ohwi)

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Abstract

Kudzu seeds of eight strains collected from various parts of Japan and one strain from the USA were scarified mechanically using a small-sized household mixer. Treatment of the seeds at a blade speed of 4,900 r. p. m. with the addition of pieces of rigid polyvinyl chloride resulted in 64 to 86% germination. Considering germination percentage, safety and time consumption, the mixer method proved to be superior to various other methods such as acid or hot water treatments, pounding, abrasion or grinding with river sand, puncturing with a needle, or an improved Denbigh disc scarifier. This method greatly simplifies propagation methods of kudzu-vine by seed.

Key words: Germination, Seed, *Pueraria lobata*.

Introduction

Hard seeds predominate in every seedlot of kudzu-vine. Such seeds are impermeable to water and require scarification before sowing. In the past some chemical and mechanical means have been proposed to scarify the seeds or to rupture the testa^{1~7)}. However, these scarification methods are of limited practical use because of drawbacks such as 1) low percentage germination, 2) care involved in handling concentrated acid, 3) considerable time involved in order to scarify manually large amounts of seeds at the same time, and 4) high costs. The development of a convenient method to scarify hard seeds is an important consideration for the large-scale cultivation of kudzu-vine.

In this study, kudzu seeds were scarified using a small-sized household mixer. The scarification method proved to be more convenient compared with previous scarification methods. In addition, germination percentages were comparable to or higher than those of other methods.

Materials and Methods

Kudzu seeds from eight strains collected in Japan and one strain in the USA, as presented in Table 1, were used. The seeds from all strains were threshed and hulled by hand.

In all strains except No. 5, 100 healthy seeds* were scarified mechanically together with about 90 pieces (about 8g) of rigid polyvinyl chloride (0.8 mm thick, 8-mm square grid, cut from photographic film containers) at $4,900 \pm 53$ r. p. m. for 60 sec in an electric mixer (VA-77G type, 700 ml capacity, manufactured by Hitachi Co. Ltd). The rotational speed of the blades was considerably reduced from the normal speed using a transformer (100 V→45 V). The pieces of plastic were used to prevent seeds from falling into a groove in the bottom of the mixer and to improve agitation. The presence of the plastic pieces also may play a role in reducing the amount of contact between the moving blades and seeds. In strain No. 5, 300 seeds each were scarified for 30 and 60 sec, respectively.

Immediately after scarification, the seeds** were

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* Well-developed seeds with a quail egg-like mottled surface pattern.

** The water did not cover the upper surface of the seeds.

Table 1. Collection sites of strains tested

Strain no.	Collection site	Collection time
1	Kamikawarazaki, Yatabe-cho, Tsukuba-county, Ibaragi Prefecture	Dec. 1985
2	Tanaka, Tsukuba-cho, Tsukuba-county, Ibaragi Prefecture	Dec. 1985
3	Kunimoto, Fukuroi-shi, Shizuoka Prefecture	Dec. 1985
4	Otani, Tokoname-shi, Aichi Prefecture	Dec. 1985
5	Morozaki, Minamichita-cho, Chita-county, Aichi Prefecture	Dec. 1985
6	Kumakawa, Fuji-cho, Saga-county, Saga Prefecture	Apr. 1986
7	Kawakami, Yamato-cho, Saga-county, Saga Prefecture	Apr. 1986
8	Uchinomaki, Aso-cho, Aso-county, Kumamoto Prefecture	Apr. 1986
9	Orange-county, North Carolina, USA	Oct. 1984

placed in water in closed petri dishes and kept in darkness at 25°C to test imbibition and germination. Imbibed and germinated seeds were counted daily and germinated seeds were removed. The germination test continued for 14 days for strain No. 5 and 10 days for the other eight strains. The seeds were considered germinated when the radicle length exceeded 1 mm.

Results

Percentages of imbibed, germinated and decayed seeds are listed in Table 2. In strain No. 5 scarified for 60 sec, two of the 300 seeds had a part of their seed coat broken off. However, no cracks or destruction of the seed coats were observed under a three power magnifier in the other nine seedlots. In all seedlots, except strain No. 5 scarified for 30 sec, scarified seeds imbibed water and swelled within three days. Non-scarified seeds had less than 10% imbibition and germination after ten days (data not shown).

Percentage germination of scarified seeds ranged from 64 to 86 %. Germination was completed within four to nine days in all seedlots except strain No. 5 scarified for 30 sec. The ungerminated seeds, although imbibed, eventually decayed.

The imbibition and germination courses of the untreated and the two scarified seedlots of strain No. 5 are shown in Fig. 1. In the untreated group, imbibition and germination were 27.2 and 27.0%, respectively, after 14 days. After 60 sec of scarification, 87% of the seeds imbibed water on the 1st day and all seeds were imbibed by the 3rd day. In the 30 sec scarification treatment, four days were required before 87% of the seeds imbibed water but two seeds had not imbibed even after two weeks. The final percentage of germination in the 60 sec treatment was 63.8%. Reduction of the scarification time to 30 sec raised percentage germination by 20.5 % but extended the germination period longer.

Table 2. Percentage of imbibed, germinated and decayed seeds in the seedlots scarified by the mixer method.

Strain no.	Scarification time (sec)	Percentage of seeds		
		Imbibed	Germinated	Decayed
1	60	100	72.0	28.0
2	60	100	81.0	19.0
3	60	100	86.0	14.0
4	60	100	68.0	32.0
5	30	99.3	84.3	15.7
	60	100	63.8	36.2
6	60	100	74.0	26.0
7	60	100	66.0	34.0
8	60	100	86.0	14.0
9	60	100	85.0	15.0

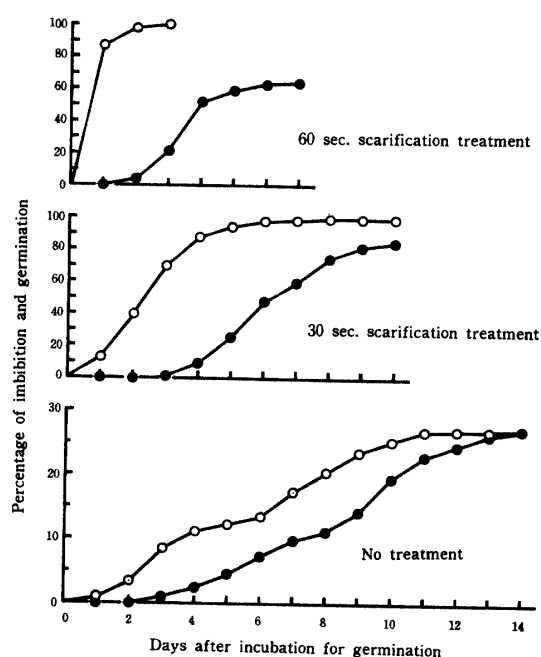


Fig. 1. Effects of scarification time on imbibition (○) and germination (●) of strain No. 5 seeds.

Discussion

OZAWA⁵⁾ used a hot water treatment for scarification in which seeds were soaked for 10 min in hot water that was allowed to cool at room temperature for 2 min after boiling (temperature range: 51–87°C). Although this method produced the highest percentage germination among warm to hot water treatments^{1,2)}, germination was only 44%. TSUGAWA *et al.*⁷⁾ and HABU *et al.*¹⁾ reported high germination of more than 80% by a conc. H_2SO_4 treatment; however, good results were not obtained by HIRAYOSHI *et al.* (1.1–11.8%)²⁾, KOBAYASHI (10–26%)³⁾ and PHIPPS (43%)⁶⁾. These disagreements are thought to be attributed to differences in treatment time. In the conc. H_2SO_4 treatment, care is required in handling the acid and the seeds must be thoroughly rinsed after the treatment. Percentage germinations were 15 and 20% respectively when seeds were pounded³⁾ or rubbed with river sand in a bag¹⁾. On the other hand, it was 87% when seeds were ground with the same amount of river sand²⁾. However, considerable time may be spent determining the proper way for each seedlot. Germination of more than 90% was obtained when the testa of seeds were punctured

at one or two points with a needle^{1,2)}. This method is not of practical use because of the time involved in treating large numbers of seeds. Scarification with a razor blade⁷⁾ has similar limitations. The improved Denbigh disc scarifier⁴⁾, made on an experimental basis for kudzu seeds in the USA in the 1940's, seems to be suitable for treating a large amount of seeds at the same time, but germination is 30% less than the present mixer method. Thus, after considering germination percentage, convenience, time and technical problems, this mixer method proved to be superior for scarification of kudzu seeds.

When scarified at 4,900 r. p. m. for 60 sec in the mixer, some strains had relatively high percentages of decayed seeds, on the order of 20 to 30%. This may be partially due to some kind of damage to the seeds when hit by the moving blades or against the wall of the glass cup. Reduction in scarification time from 60 to 30 sec at the same rotational speed lowered the percentage of decayed seeds by 20%. It may be possible to reduce further the percentage of decayed seeds by selecting suitable combinations of blade rotational speed, scarification time and buffer materials. However in our test, even slightly higher blade speeds resulted in significant damage to many seeds (data not shown).

In another trial, 10g of seed pods of a different strain were hulled at about 6,900 r. p. m. for 60 sec in the same mixer. Without further treating the seeds, they had 82% imbibition and the imbibed seed had 82% germination. This result indicates that the seeds were scarified during the hulling operation. Hence, if the rotational speed of the mixer blades, the treatment time and the amount of seed pods are properly selected, hulling and scarification can be accomplished at the same time. This greatly simplifies large-scale propagation of kudzu-vine by seed, although it may be unsuitable for long-term storage of seeds. Furthermore, this mixer method may be applicable to the scarification of hard seeds of other forage legumes.

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家庭用ミキサーによるクズの種皮処理

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要 約

わが国各地から集めた8系統，米国産1系統，計9系統のクズ種子について家庭用ミキサーによる種皮処理を試みた。100または300粒の種子を8gの硬質塩化ビニール薄片(8mm角，厚さ0.8mm)とともに30秒または60秒間，刃の回転数4,900 r. p. m. のミキサーにかけたところ，64ないし86%の発芽率を得た。これは， H_2SO_4 処理，温一熱湯処理，川砂と搗く，揉む，あるいは擦る方法，針刺法および米国で試作された改良型 Denbigh disk scarifier 処理等によりこれまでに得られた発芽率と比較して，同等ないし，より高かった。また，取扱い易さの点についても，本ミキサー法は従来の方法よりすぐれた種皮処理法であるといえる。したがって，本方法は種子によるクズの繁殖法確立のために大いに貢献するものと期待される。

キーワード：クズ，種子，発芽。