Assessment of seed characteristics of progenies in tea (*Camellia sinensis* L.) seed gardens: towards facilitating effective utilization of tea seeds and the productivity enhancement of the gardens

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1. Introduction

Tea seeds were used as the only source of planting material at the beginning of the tea industry and later replaced by the improved vegetatively propagated (VP) cultivars. However, as an alternative planting material to combat effects of global climate change, there is reviewed interest among growers for seeds. With the expansion of the tea industry, the natural vegetation of tea has been undergoing significant alteration in the recent years and as a result, key seed characteristics such as storage, germination etc. have gained increasing attention (Song et al., 2018).

In Sri Lanka improved seed progenies developed in isolated tea seed gardens are in the eve of recommendation as an adaptation measure to climate change. Reproductive phenology and breeding system studies in seed gardens have been conducted simultaneously (Piyasundara et al., 2018) to plan and implement productivity enhancement programmes of seed gardens in order to ensure availability of adequate materials before making the recommendations.

Some basic studies on effect of storage on germination have been conducted and information are available. However, information on seed germination of progenies developed from different parental cultivars in seed gardens are not available. This information is immensely useful in utilizing these progenies in commercial planting. Therefore, the present study conducted to assess the variations in key seed characteristics: seed weight, time taken to 50% germination and germination percentage of seed progenies derived from parental cultivars of selected tea seed gardens. Aiming to utilize the information for effective utilization of seeds and productivity enhancement programmes to fulfil the increasing demand of the growers.

2. Materials and Methods

Study was conducted in a representative sample of three isolated tea seed gardens: One Bi-clonal Garden at Reucastle Estate, Dehiowita and two Poly-clonal Gardens at Salawa Estate, Hanwella and Rambukkanda Estate, Ratnapura. The Gardens were selected based on adequate representation of parental cultivars and the performances of seed progenies found in adaptive trials conducted previously (Piyasundara et al., 2012). Study was carried out during April to August 2018, the peak fruiting season of the year.

Two hundred mature fruits were collected from each parental cultivar at each location: 40 fruits each from five randomly selected healthy trees.

Pericarps were removed and seed weight of cleaned seeds were recorded at the laboratory. Seeds were soaked overnight for floater-sinker assessment. Then seeds were propagated in standard clean sand bed in RCBD (Randomized Complete Block Design) in four replicates comprising 50 seeds each.

Observations were made in regular intervals till germination commenced, germination was defined as when radical pierced the seed coat. Observations continued up to 8 weeks.

Germination percentage was calculated as described by Yang et al., 1999.

$$\text{Germination percentage} = \frac{\text{Number of germinated seeds}}{\text{Total number of seeds}} \text{ X } 100$$

Number of days taken to reach 50% germination of each progeny also recorded.
The data subjected to two factor factorial analysis and mean comparison based on Duncan's test using SAS.

3. Results and Discussion

Factorial analysis of the data reveled there was no significant interaction with the location (garden) in both seed weight and germination percentage of the progenies. In the cultivars which are present in more than one location (TRI 2027, TRI 3055, KEN 16/3 and S 106). Therefore, mean comparison of both seed weights and germination percentage was carried out of 13 seed progenies of 9 parental cultivars of the 3 locations. TRI 3047 present in Both Salawa and Rambukkanda did not produce seeds at all.

The results revealed that significant variations in seed weights (Table 1) among the progenies of different parental cultivars.

Table 01. Mean seed weight and number of seeds per kilograms of 13 seed progenies

Seed Progeny	Mean seed weight (g) N=200	No. of seeds per kilogram*
Rambukkanda - TRI 2025	$2.99^{a} \pm 0.04$	334
Rucastle -TRI 3063	$2.81^{b} \pm 0.05$	356
Rambukkanda - TRI 2022	$2.80^{b} \pm 0.05$	357
Salawa - TRI 2016	$2.55^{c} \pm 0.05$	392
Rambukkanda -KP 204	$2.52^{cd} \pm 0.05$	397
Rambukkanda - TRI 3055	$2.40^{de} \pm 0.05$	417
Salawa -TRI 3055	$2.38^{e} \pm 0.05$	420
Reucastle -S 106	$2.32^{ef} \pm 0.05$	431
Salawa -S 106	$2.29^{ef} \pm 0.05$	437
Rambukkanda - TRI 2027	$2.25^{gf} \pm 0.04$	445
Salawa - TRI 2027	$2.21^{gf} \pm 0.04$	453
Rambukkanda - KEN 16/3	$2.21^{gf} \pm 0.04$	453
Salawa - KEN 16/3	$2.14^{g} \pm 0.04$	467
CV	26.71	

* calculated based on mean seed weight / ± standard error

Progenies derived from three cultivars: TRI 2025, TRI 2022 and TRI 3063, exhibited comparatively higher mean seed weights and progenies of four cultivars TRI 2016, KP 204, TRI 3055 and S 106 with medium seed weights. Progenies of TRI 2027 and KEN 16/3 recorded the lower seed weights. Table 1 further compares number of seeds per kilograms of seeds in each progeny.

Seed germination commenced 21 days after sowing and notable deviations observed in the time taken to reach 50% germination among the progenies (Figure 1). Progenies of cultivars KEN 16/3, S 106 and TRI 2016 reached 50% germination in comparatively shorter time period.

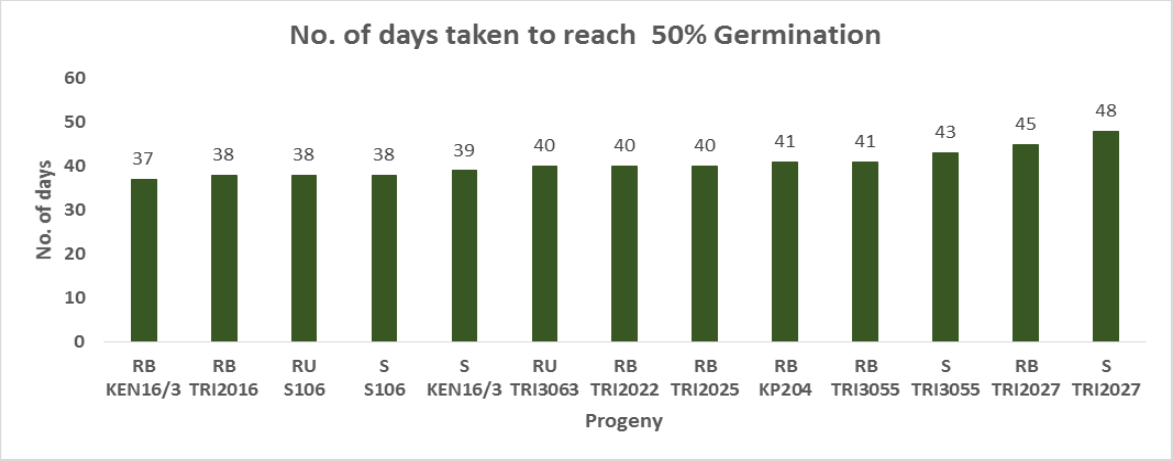

Figure 1. No. of days taken to reach 50% germination

Significant variations were recorded in mean seed germination percentage (Figure 2) among the 13 progenies.

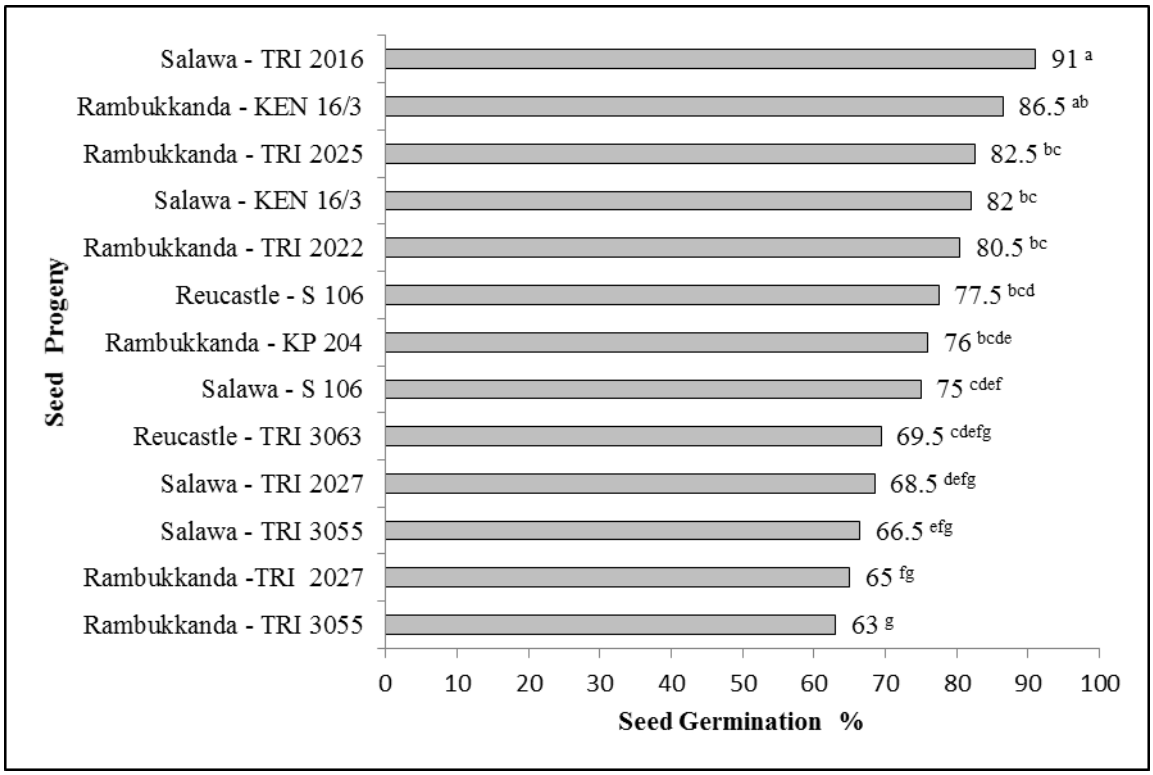

Figure 2. Mean seed germination percentages of the thirteen seeds progenies (Means with the same letter/s are not significantly different)

The highest mean germination percentage was exhibited in the progeny of Salawa TRI 2016. Out of the 13 progenies 8 (of 6 parental cultivars) recorded comparatively higher (over 75%) germination. In the meantime, 5 progenies (of 3 parental cultivars), recorded comparatively moderate (63 – 69.5%) germinations.

Both seed weight and germination collectively indicates productivity of each seed progeny. The parental cultivars with comparatively higher seed weights as well as ones with comparatively lower seed weights have exhibited higher germination parentages suggesting that there is no direct relationship between seed weight and germination percentage. However, should be studied further before coming to a final conclusion.

Findings of the present study is summarized (Table 2) along with findings of previous study on Reproductive phenology (Piyasundara et al, 2018) to utilize the information to facilitate seed collection & handling and as well as to select suitable parental cultivars for future gardens.

Table 02. Summary of the seed characteristics and fruit setting potential of the nine parental cultivars of the 3 gardens

Parental cultivar	Germination %	Number of seeds per 1 kg	Fruit setting potential*
TRI 2016	High	Medium	High
TRI 2022	High	Low	High
TRI 2025	High	Low	High
TRI 2027	Moderate	High	Moderate
TRI 3055	Moderate	Medium	Moderate
TRI 3063	Moderate	Low	Moderate
KEN 16/3	High	High	High
KP 204	High	Medium	Moderate
S 106	High	Medium	High

* Piyasundara et al., 2018

4. Conclusions

Seed weight and germination percentage is cultivar specific other than the location. Seeds collected from cultivars KEN 16/3, TRI 2016, S 106 and KP 204 characterized with comparatively low to medium seed weight and high germination percentage are more effective and economical for commercial planting. Seeds collected from cultivars TRI 2022 and TRI 2025 characterized with comparatively high, seed weight and germination percentage is the next option. Information generated useful in rational selection of parental combinations for future gardens aiming to fulfil the increasing demand for tea seeds among the growers.

5. References

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