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EFFECT OF HOT AND COLD WATER TREATMENT DURATIONS ON EMERGENCE OF TEPHROSIA (*Tephrosia bracteolata* Perr. Guil.) SEEDS

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Abstract

An experiment was conducted at the Forage Laboratory of Feeds and Nutrition Research Programme, National Animal Production Research Institute, Shika-Zaria to investigate the effect of hot and cold water treatment durations on seeds germination and emergence of Tephrosia seeds. A total of 825 clean healthy seeds of T. bracteolata were divided into 11 treatments durations using hot water at 60^0C and cold water at room temperature for 0, 2, 4, 6, 8, 10 minutes and 2, 4, 6, 8 and 10 hours, respectively. The untreated served as the control (0). The treatments were replicated three times and arranged in a completely randomized design (CRD). Hot and cold water treatment durations had significant ($P<0.05$) influence on percentage seed germination, emergence dormancy and seedling vigour. There was no significant ($P>0.05$) effect on the seedling length in hot water treatments and the control. Treatments of Tephrosia bracteolata in hot and cold water proved very effective for seed germination and enhancement, dormancy alleviation and increased seedling vigour. The highest value of 80.33% was obtained for hot water treatment duration at 8 minutes and 72.00% for cold water at 10 hours for percentage germination obtained. Seedling vigour index (1041.33) was better at 8 minutes hot water treatment than (986.0) at 10 hours treatment in cold water. There was no significant interactions between hot and cold water treatment except at emergence of the seeds. From the research conducted, treatment of T. bracteolata seeds in hot water up to 8 minutes optimum and cold water up to 10 hours soaking durations is recommended to farmers and researchers for enhanced seed germination and optimum potential seedling establishment.

Keywords: *Hot and cold water, germination, emergence, Tephrosia seeds, shrub-like legume*

INTRODUCTION

One of the reasons for poor pasture establishment is inadequate seed treatment before planting. Seed priming is one of those ways to improve seed germination and emergence of most leguminous plants. It is a procedure by which seeds are soaked and then dried back to its original water content before planting (Harris, 2002). Seed treatment is a pre-sowing strategy for influencing seedling development by modulating pre-germination metabolic activity prior to emergence of the radicle and generally enhances germination rate and plant performance (Ajit *et al*., 2014).

Tephrosia is a tropical shrub-like legume whose seed has to be treated in water for improved seed germination and emergence. The leaves of this plant are highly valued by rural dwellers for livestock feeding because of its ability to fix atmospheric nitrogen which will subsequently help to improve soil fertility (Lamidi *et al.*, 2013). The plant is considered a weed in most pastures. It is one of the cheapest forage sources of protein to satisfy ruminant livestock nutritional requirements because their nitrogen content is a satisfactory substitute for more expensive protein supplement **(**Ogunbesan *et al.*, 2011). In Western part of Nigeria, it is called "Roro" and also being "praised-song" as that which enables does (female goats) to give birth to quadruplet and ewes (female sheep) to give birth to triplets (Babayemi *et al.* 2003,

Ogunbesan *et al.* 2011). It is also called "saragomai" in the Northern part of Nigeria. It is one of the cheapest forage sources of protein that satisfies ruminant livestock nutritional requirements (Ogunbesun *et al.,* 2011). Tephrosia leaves are readily available to the peasant farmers and highly relished both as hay and in the fresh form by different classes of ruminants. The plant is usually harvested by children, women and peasant farmers for fattening their rams close to "Eid-Eil Kabir" festival period usually when the plant is at flowering stage (Ogungbesan *et al*., 2011). However, because of the validity attached to this plant by peasant farmers and researchers, there is need to domesticate and propagate *T. bracteolata* in large quantity. The objective of this study was to determine the effect of hot and cold water treatment durations on the germination and emergence of *Tephrosia bracteolata* seeds.

MATERIALS AND METHODS

A germination and emergence trial was conducted in 2015 cropping season at the forage laboratory of Feeds and Nutrition Research Programme, National Animal Production Research institute (NAPRI) Shika, Ahmadu Bello University, Zaria. Shika is located on latitude 11^0 12 N, longitude 07^0 33' E and altitude 660m above sea level in Northern Gu/inea Savannah of Nigeria (Ovimaps, 20+12). The wet season starts from April to early May and ends in late September to early October. Long-term annual rain fall ranges from 1110 - 1580mm with a maximum temperature of 30^0C and relative humidity of approximately 70% (IAR, 2009).

Source of Seeds

Tephrosia bracteolata was harvested in October, 2014 when the pods had turned brownish. They were collected as weeds from the breeder seed plots of *Andrpogon gayanus, Chloris gayana* and *Digitaria decumbens.* The plants were cut with a sickle and sun dried for 24 hours. Seeds were threshed, winnowed and separated from the pods. The seeds were collected and stored in polythene bags before germination test was carried out.

Seed treatment

Clean, healthy seeds of *T. bracteolata* collected were subjected to 11 treatment durations in hot and cold water. The treatments were 0 (control), 2, 4, 6, 8 and 10 minute and 2, 4, 6, 8 and 10 hours treatment durations in hot and cold water respectively. A total of 825 seeds were sorted, counted and divided into two portions (hot and cold) and then the control (untreated). The treatment had 75 seeds and replicated three times. The seeds to be treated were wrapped in clean clothes and placed in 500 mls of hot water at 80^0C, while those of cold water were placed in 500 mls at a room temperature of 27^0C. The placement were done at the same time and withdrawn at the expiration of the treatment period and seeds receiving hot water treatment were cooled down under a running tap for 5 minutes according to Babayemi *et al*. (2003a). There after seeds were spread thinly to allow air dry and were used the next day for germination and emergence test.

Germination test

The treated seeds of *Tephrosia bracteolata* were placed in petri dishes with transparent lid cover lined with two layers of Whiteman filter paper and watered to provide moist environment. Twenty five (25) seeds of *T. bracteolata* were replicated 3 times and arranged in a regular equivalent pattern on the surface of the moist filter paper inside the petri dishes totalling 75 seeds per treatment durations for hot, cold water and the control making 11 treatment durations. The seeds were arranged in a Completely Randomized Design. Watering and germination counts began 48 hours after the commencement of the experiment according to the procedure described by Odediran and Babayemi

(2007). Germination percentage was computed using the formula below:

Germination percentage =
Total seed germinated ×100
Total seed sown

Seedling emergence

A pot experiment was carried out for seedling emergence. The treated seeds of *T. bracteolata* were planted in 17 cm x 13 cm plastic containers. The containers were filled with sandy-loam soil collected at Forage Experimental Plot of National Animal Production Research Institute, Zaria. Water was added to the soil until there was seepage from the holes drilled at the base of the containers to prevent water logging. A count of healthy 25 seeds were planted at equidistance of 0.5 m apart and replicated 3 times for each of the treatments duration for hot and cold water. The percentage seedling emergence was calculated using the formula:

Emergence percentage =

Total seed emerged × 100
Total Seed sown

Seedling vigour index (SVI) = [seedling length (cm) x germination percentage]

Data was collected on seed germination, emergence, dormant seeds, seedling length and seedling vigour which was subjected to analysis of variance (ANOVA) procedure for using Statistical Analysis System (2005) software. Significantly different means were separated using Duncan multiple range test of the same SAS package.

RESULTS AND DISCUSSION

Percentage germination

The percentage germination (Table 1) was significantly ($P<0.05$) influenced by treatment duration in both hot and cold water for the *Tephrosia bracteolata* seeds. The percentage germinations increased as the treatment duration increased from 2 minutes (46.00%), 4 and 10 minutes (54.67%), 6 minutes (67.67%), 8 minutes (80.37%) as the highest value recorded for hot water treatment durations. The control untreated had the lowest value (16.67%). This was an indication that the optimum duration for hot water treatment of *Tephrosia bracteolata* seeds was obtained at 8 minutes. During cold water treatment, the value obtained significantly increased as the treatment duration increased from 2 to 10 hours. The highest value (72.00%) obtained was not up to the value obtained when treated in hot water. The result also showed that it was better to use hot water treatment to enhance germination than using cold water treatment method. This may be attributed to the fact that seeds absorbed more water in hot water treatment than cold water treatment which activated the germination process within the seed and the radicle emerge through the seed coat. This agrees with the result of Babayemi *et al*., 2003 who reported that soaking *Tephrosia bracteolata* in boiled water proved very effective for seed germination enhancement, dormancy alleviation and an increase in the rate of seed germination. The result also agrees with Musa *et al.* (2014) who reported that primed or treated seeds have better efficiency for water absorption from imbibition medium and it is obvious that metabolic activities in the seed during the germination process commenced much earlier than emergence of radicles and plumules. Singh *et al.* (2012) reported that the difference in the germination percentage of the primed (treated) and unprimed (untreated) seeds were clear indicators for physiological changes due to enzyme activation and softening of the seed coat. Babayemi *et al.* (2003) also reported that the germinability of *T. bracteolata* species is enhanced when soaked in boiled water between 30 seconds to 5 minutes. The result of this study showed an improvement in germination of *T. bracteolata* at 8 minutes in hot water and 10 hours in cold water. There was no

significant interaction between hot and cold water treatments on percentage germination of seeds.

Percentage emergence

The percentage emergence (Table 2) was significantly (P<0.05) different in all the treatments in both the hot water and cold water trials. Soaked seeds were better than the unsoaked seeds. The percentage emergence increased from 63.00% to 76.00% at 2 to 8 minutes and reduced to 56.67% at 10 minutes when optimum value was reached. The values of 2 to 10 hours in cold water were 21.00%, 42.67%, 46.00 %, 51.00 % and 70.00% which was the highest value obtained and was significantly (P<0.05) lower when compared with that in hot water treatment. The percentage emergences of the unsoaked seeds (control) were significantly lower in both treatments 14.00 % and 16.33 % respectively. These finding showed that soaking in hot or cold water could be the attributing factor which allowed physiological changes and enzymatic activities that aided seedling emergence. This agrees with the reports of Bailly *et al*, 2000 and Musa *et al*., 2014 who reported that primed (soaked) seeds emerged faster than the unprimed (unsoaked) seeds. The values of percentage emergence obtained for the control were lower than 19.5 % reported by Babayemi *et al*., (2003) for Tephrosia species seeds without any pre-treatments, necessitating the need for pre-treatment before sowing. There was significant interaction between hot and cold water treatments probably due to differences in time durations (minutes x hours).

Percentage dormant seeds

The percentage dormant seeds have been presented in (Table 3). The dormancy of *T. bracteolata* decreased as the duration of treatment decreased significantly from 2 to 10 minutes and 2 to 10 hours as compared to the unsoaked. The value (83.33%) obtained for hot water treatment was the highest than that obtained (82.00%) in cold water treatment but was not significantly different. The result was an indication that seed treatment decreased seed hardiness and improved seed germination. Dormancy of *T. bracteolata* seeds might be due to immaturity of seeds or poor storability. Babayemi *et al*. (2003) reported that heat appears to be essentially in dormancy alleviation treatment for *T. bracteolata* seeds. There was no significant interaction between hot and cold treatments on percentage dormancy of seeds.

Seedling length

The result in (Table 4) showed that there was no significant difference (P<0.05) observed in seedling length (11.67cm - 14.00cm) in hot water treatment but significant (P<0.05) difference occurred when cold water treatment was used from (10.67%) the lowest to (14.33%) highest value at 0 hour to 10 hours treatment durations respectively. This variation may be attributed to longer hours of soaking in cold water than short period of soaking in hot water. There was no significant interaction between hot and cold treatments for seedling length.

Seedling vigour index

The effect of hot and cold water treatment durations on seedling vigour was presented in (Table 5) of *T. bracteolata* seeds. There were significant (P<0.05) difference in all the soaked seeds as compared to the control. The seedling vigour was improved as treatment durations were increased. The value of seedling vigour in the hot water treatment ranged from 624.00 to 1041 and from 466.33 to 986.00 in the cold water treatment both of which were higher than the control treatments (196.00 and 190.67). Wahid *et al.* (2008) reported that seed soaking or priming reinforces seed vigour and an increase in shoot and radicle length might be due to induction of metabolic activities in embryo as a result of seed priming (soaking). There was no significant interaction between hot and

cold treatments in terms of seedling vigour.

CONCLUSION AND RECOMMENDATION

Hot and cold water treatment durations have significantly improved more than 50% of *Tephrosia bracteolata* seeds in terms of germination, emergence and seedling vigour. Therefore, *Tephrosia bracteolata* seeds should be treated in hot water for a period of 8 minutes optimum and in cold water for 10 hours before planting to achieve maximum potential seed germination and improve seedling vigour. However, hot water treatment method has a lower duration compared to the cold water treatment method. Interaction between hot and cold water treatments was significant only at emergence of seeds. The implication of this research is that farmers in and around the study area can now soak *Tephrosia bracteolata* seeds in hot or cold water in order to improve their seed germination and emergence.

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Table 1: Effect of hot and cold water treatment durations on percentage germination of *Tephrosia bracteolata* seeds

Percentage germination		
Treatments	Hot water treatment	Cold water treatment
Duration	(minutes)	(hours)
0	16.67[e]	18.00[e]
2	46.00[d]	40.33[d]
4	54.67[c]	49.00[c]
6	67.67[b]	52.67[c]
8	80.33[a]	61.67[b]
10	54.67[c]	72.00[a]
SE (±)	4.87	1.91
	*	*
Interaction hot x cold	NS	NS

*****means with the same letter (s) within a column are not significantly different (P<0.05)

Table 2: Effect of hot and cold water treatment durations on the Emergence of *Tephrosia bracteolata* seeds

Percentage emergence		
Treatments	Hot water	Cold water
Duration	(minutes)	(hours)
0	14.00[d]	16.33[c]
2	63.00[bc]	21.00[c]
4	65.33[abc]	24.67[c]
6	72.67[ab]	46.00[b]
8	76.00[a]	51.00[b]
10	56.67[c]	70.00[a]
SE (±)	5.17	2.11
	*	*
Interaction hot x cold	0.0094	0.0094

*****means with the same letter (s) within a column are not significantly different (P<0.05)

Table 3: Effect of hot and cold water treatment durations on the percentage dormancy of *Tephrosia bracteolata* seeds

Percentage dormancy		
Treatments Duration	Hot water (minutes)	Cold water (hours)
0	83.33[e]	82.00[e]
2	54.00[d]	59.67[d]
4	45.33[c]	51.00[c]
6	32.33[b]	47.33[c]
8	19.67[a]	38.33[b]
10	45.38[c]	28.00[a]
SE (±)	4.87	1.91
	*	*
Interaction hot x cold	NS	NS

*****means with the same letter (s) within a column are not significantly different (P<0.05)

Table 4: Effect of hot and cold water treatment durations on seedling length of *Tephrosia bracteolata* seeds

Seedling length (cm)		
Treatments Duration	Hot water Minutes	Cold water Hours
0	11.67	10.67[b]
2	13.67	11.67[ab]
4	13.33	11.67[ab]
6	14.00	13.67[ab]
8	13.00	13.67[ab]
10	12.00	14.33[a]
SE (±)	0.35	0.55
	NS	*
Interaction hot x cold	NS	NS

*****means with the same letter (s) within a column are not significantly different (P<0.05)

Table 5: Effect of hot and cold water treatment durations on the percentage seedling vigour of *Tephrosia bracteolata* seeds

Seedling vigour index		
Treatments	Hot water	Cold water
Duration	(minutes)	(hours)
0	196.00^{c}	190.67^{d}
2	624.00^{b}	466.33^{c}
4	731.67^{b}	570.67^{bc}
6	948.00^{a}	720.0^{b}
8	1041.33^{a}	879.33^{a}
10	662.67^{b}	986.0^{a}
SE (±)	68.45	25.34
	*	*
Interaction hot x cold	NS	NS

*****means with the same letter (s) within a column are not significantly different ($P<0.05$)