Journal of Agriculture and Environment Vol. 6 Nos.1&2, 2010: 105-108
ISSN 1595-465X

SHORT COMMUNICATION

EFFECTS OF PLANT-DERIVED SMOKE PRIMER AND TEMPERATURE ON THE GERMINATION OF *Solanum tomentosum* (L.) SEEDS

A. A. Aliero[1] and A. J. Afolayan[2]
[1]Department of Biological Sciences, Usmanu Danfodiyo University, Sokoto, Nigeria

[2]Department of Botany, University of Fort Hare, Alice, 5700, South Africa

Introduction

Solanum tomentosum L. (Solanaceae), known as snake apple, is indigenous to South Africa. It is a shrub that grows up to 60 cm high and occurs on roadsides, undisturbed soils and rocky grasslands in the coastal belt of South Africa (Batten and Bokelmann, 1966). The stems are densely covered with shiny reddish-brown prickles and bear clusters of brightly orange berries. It is used in herbal medicine for the treatment of syphilis, sore throat, toothache and boils. Extracts from the leaves have been reported to be active against strains of bacteria and fungi (Aliero and Afolayan, 2006). The authors observed that the population of this herb was low in the wild, which may be attributed to its intensive harvesting for medicinal purposes coupled with its low potential for natural regeneration.

Seed dormancy and germination are complex adaptive traits of higher plants that are influenced by a large number of internal and environmental factors (Koornneef *et al*., 2002). These factors make natural re-seeding insufficient to guarantee survival ability of many species. This might be the case in *S. tomentosum.* Prior to this study, not much has been documented on its biology, particularly on the factors affecting its seed germination. Previous study by Mblulawa *et al*. (2005) on the germination of its seeds was focused on the influence of light, temperature and stratification. The study revealed that light and low temperature did not improve seed germination in this plant; however, low germination was obtained when the seeds were scarified. The role of high temperature in stimulating seed germination of many species has been reported by several authors (Tarrega *et al*., 1992; Koduru *et al*., 2006).

In recent time, plant derived smoke has been reported to stimulate seed germination in many plants (Baxter *et al*., 1994; Baxter and Van Staden, 1994; Baxter *et al*., 1995; Brown and Van Staden, 1997; Sparg *et al*., 2005). In an attempt to promote germination in this plant, the effect of plant derived smoke and high temperature on the germination of its seeds were investigated.

Material and Methods

The seeds used in this study were obtained from fruits of *S. tomentosum* harvested from a natural population within the Nkonkobe Municipality of the Eastern Cape, while the instant smoke primer® was obtained from the Kirstenbosch, National Botanical Garden, Cape Town, South Africa. This work was conducted in the Department of Botany, University of Fort Hare, South Africa. Seeds viability was determined using the tetrazolium techniques of Peters (2000) procedures for Solanaceae. Each smoke impregnated paper was soaked in 10, 50,100 and 500 ml of water for 5 min to allow the diffusion of smoke into water. Seeds were soaked in smoke-impregnated water for 12, 24 and 36 hrs, before they were transferred in 9 cm Petri dishes lined with two Whatman No.1 filter papers and moistened with sterile distilled water to ensure adequate moisture for the seeds. Three replicates of 50 seeds each were used for each treatment. Untreated seeds soaked in distilled water were used as control. The four smoke concentrations were tested at three periods of soaking. The effect of four temperature regimes (60, 80, 100 and 120 ºC) at four soaking durations (5, 15, 30 and 45 min.) were maintained on three replicates of 25 seeds each placed on one layer of filter paper (Schleicher & Schuell, Whatman, England) in separate 9-cm-diameter petri dishes. The filter paper was wetted with distilled water. Treatments were arranged in a completely randomized block design consisted of smoke and temperature as main treatments each with four and three factors respectively and replicated thrice. The number of germinated seeds was recorded daily for 15 days and the number of germinated seeds was expressed in percentage.

Data collected were subjected to analysis of variance (ANOVA) using Statistical Analysis System (SAS) Software. Significant differences within the means of the treatments were calculated using the LSD statistical test at 5% probability.

Results and Discussion

S. tomentosum seeds did not germinate when soaked in low concentration of smoke. On the other hand, high germination of more than 80% was recorded under a high smoke (1:10) concentration (Table 1). This implies that the seeds of *S. tomentosum* are stimulated by high concentration of smoke for germination, but low concentration was found to be non-stimulatory.

Table 1: Effects of smoke primer on the germination of *S. tomentosum* seeds (n =3)

Concentration	Soaking duration (hours)		
	12	24	36
Control	-	-	-
1/10	80.00 ± 17.64^{a}	82.62 ± 9.21^{a}	82.41 ± 12.62^{a}
1/50	5.00 ± 8.66^{b}	23.62 ± 15.17^{b}	27.10 ± 6.67^{b}
1/100	1.60 ± 0.0^{b}	8.61 ± 3.40^{c}	6.72 ± 2.12^{c}
1/500	-	-	-
S.E. $\pm$	7.25	6.63	7.46

Values represent mean and standard deviation of percentage germination. Mean in a column followed by same letter (s) are not significantly different at (P> 0.05).

The percentage germination increased with increasing soaking period with the exception of seed soaked for 24 and 36 hours in 1:100 smoke concentration. The high percentage germination of *S. tomentosum* induced by smoke extract (1:10) may be attributed to the concentration of the smoke extract in the aqueous medium. Water saturated with smoke has been found to contain ethylene as well as octanoic acid, both of which are capable of stimulating germination (Sutcliffe and Whitehead, 1995). It is possible that the presence of octanoic acid in the smoke extract resulted in the stimulation of germination depending on the period of exposure of the seeds. In a similar work, Koduru *et al*. (2006) found that the seeds of *Solanum aculeastrum* did not germinate in low smoke concentration. However, in Lettuce, smoke extract brought about a concentration dependent increase in germination and a complete inhibition of germination at high concentrations (Jäger *et al*., 1996). According to Brown and Van Staden (1997), variations in species responses to smoke may be related to differential sensitivity to active compounds.

Generally, the effect of temperature on the germination of *S. tomentosum* seeds was insignificant (P>0.05) and very low percentage was recorded (Table 2). The highest seed germination of 32% was recorded in seeds incubated at 60°C for 30 min. The role of high temperature in stimulating seed germination of many species has been reported by several authors (Tarrega *et al*., 1992; Koduru *et al*., 2006). In this study, increased incubation temperature and period of exposure did not improve seed germination.

Table 2: Effect of high temperatures and duration of exposures on the germination of *S. tomentosum*.

Temperature (^{0}C)	Period of exposure (min.)			
	5	15	30	45
60	0.00^b	4.00^b	32.00^a	0.00
80	4.00^a	12.00^a	0.00^b	0.00
100	4.00^a	12.00^a	0.00^b	0.00
120	4.00^a	0.00^c	0.00^b	0.00
S.E. ±	0.73	0.18	0.33	0.00

Mean in a column followed by same letter (s) are not significantly different at (P> 0.05).

The inability of *S. tomentosum* seeds to germinate under normal conditions may have direct impact on its population in the wild and its subsequent exploitation in medicine. The results obtained in this study suggest that smoke primer could be useful in the improvement of seed germination of this species which may help in the promotion of its conservation initiatives.

References

Aliero, A. A. and A. J. Afolayan (2006). Antimicrobial activity of *Solanum tomentosum African Journal of Biotechnology*. 5: 369-372.

Aliero, A. A. and A. J. Afolayan (2006). Antimicrobial activity of *Solanum tomentosum African Journal of Biotechnology*, 5: 369-372.

Batten, A. and H. Bokelmann (1966). *Wild flowers of the Eastern Cape Province*. Cape and Transvaal Printers Limited, Cape Town 129p.

Baxter, B. J. M. and J.Van Staden (1994). Plant-derived smoke: An effective seed pre-treatment. *Plant Growth Regulation*. 14: 279–282.

Baxter, B.J.M., J. E. Granger and J Van Staden (1995). Plant-derived smoke and seed germination: Is all smoke good smoke? That is the burning question. *South African Journal of Botany*. 61: 275–277.

Baxter, B.J.M., J.Van Staden, J.E. Granger and N.A.C. Brown (1994). Plant-derived smoke and smoke extracts stimulate seed germination of the fire-climax grass *Themeda triandra* Forssk. *Environmental and Experimental Botany*. 34: 217–223.

Brown N.A.C.and J. Van Staden (1997). Smoke as a germination cue: a review. *Plant Growth Regulation*. 22: 115–124.

Jäger, A. K., A. Strydom and J. Van Staden (1996). The effect of ethylene, octanoic acid and a plant-derived smoke extract on the germination of light-sensitive lettuce seeds. *Plant Growth Regulation*. 19(3): 197-201.

Koduru, S., D. S. Grierson and A. J. Afolayan (2006). Effect of high temperatures on seed germination of *Solanum aculeastrum*. *Asian Journal of Plant Sciences*. 5: 353-356.

Koornneef, M., L. Bentsink and H. Hilhorst (2002). Seed dormancy and germination. *Current Opinion in Plant Biology*. 51: 33-36.

Mblulawa, Z. Z., P. O. Adebola, A. J. Afolayan (2005). Effects of light, temperature stratification on the germination of *Solanum tomentosum* L. (Solanaceae) seeds. A poster presented at the Indigenous Plant Use Forum. The Eden Grove Conference CentreRhodes, University of Grahamstown, Eastern Cape Provice, South Africa, 27th -30th June.

Peters, P. (2000). *Tetrazolium Testing Handbook, Contribution No. 29*. The Handbook on Seed Testing. Prepared by the Tetrazolium Subcommittee of the Association of Official Seed Analysts. Part 2. Lincoln, Nebraska.

Sparg, S. H., M. G. Kulkarmi, M. E. Light and J. Van Staden (2005). Improving seedling vigour of indigenous medicinal plants with smoke. *Bioresource Technology*. 96: 1323-1330.

Sutcliffe, M. A. and C. S. Whitehead (1995). Role of ethylene and short-chain fatty acids in the smoke-stimulated germination of Cyclopia seed. *Journal of Plant Physiology*. 145 (3): 271-276.

Tarrega, R., L. Calvo and L. Trabaud (1992). Effect of high temperatures on seed germination of two woody Leguminosae. *Plant Ecology*. 102 (2):139-147