African Journal of Biotechnology Vol. 8 (6), pp. 1078-1081, 20, March 2009
Available online at http://www.academicjournals.org/AJB
ISSN 1684–5315 © 2009 Academic Journals

Full Length Research Paper

Effects of pre-chilling and temperature on seed germination of *Corchorus olitorius* L. (Tiliaceae) (Jew's Mallow), a wild leafy vegetable

M. Nkomo and L. Kambizi[1]*

Biological Sciences Department, Walter Sisulu University, P/Bag X1 Mthatha 5117, South Africa.

Accepted 10 November, 2008

The wild leafy vegetable, *Corchorus olitorius* L, has a potential for development as a crop. Self propagation of this species is by seed. In an attempt to improve the length of time of its availability, the effects of pre-chilling and temperature on germination of its seeds were investigated. Although it had a seed viability of 90.1% (using the tetrazolium technique), seed subjected to a temperature of 25°C for both pre-chilled and unchilled seeds showed no germination. Seeds subjected to a temperature of 35°C did germinate with a maximum of 88% germination from seeds that had been pre-chilled for 3 ½ days compared to those which were unchilled, pre-chilled for a day or pre-chilled for 7 days. Pre-chilling followed by exposure to a temperature higher than 30°C encourages germination of *C. olitorius* seeds. Nursery establishment under such conditions may improve its length of availability.

Key words: *Corchorus olitorius,* germination, temperature, pre-chilling, wild vegetable.

INTRODUCTION

In South Africa, the use of leafy vegetables is as old as the history of modern man (Jansen van Rensburg et al*.,* 2007). Collection and cultivation of these vegetables continues to be widespread among black South Africans (Bhat and Rubuluza, 2002; Jansen van Rensburg et al*.,* 2004, Husselman and Sizane, 2006; Modi et al*.,* 2006).

In the Eastern Cape Province, the use of wild vegetables continues to be relatively high, which is compounded by the marginal socio-economic status of most of the population. Quantitatively, the consumption of leafy vegetables collected from the wild or as weeds tends to be inversely proportional to household income (Vorster et al*.,* 2002). Poor households tend to use these types of leafy vegetables more than wealthier counterparts, because they lack the financial means to purchase vegetables and the wherewithal to produce their own (Vorster et al*.,* 2002). The use of wild food forms part of a safety devise that rural people use to cope with poverty, disaster and livelihood stress (Rose and Guillarmod, 1974; Rubaihayo, 1997; Shackleton et al*.,* 2000).

*Corresponding author. E-mail: Lkambizi@wsu.ac.za. Tel: +27475022274. Fax: +27866586969.

The collection of leafy vegetables and the knowledge associated with this practice was a female domain among both the Koisan (Fox and Young, 1982; Parsons, 1993) and the Bantu-speaking tribes (Jansen van Rensburg et al., 2004). In some rural areas of the Eastern Cape, this practice continues to be associated with women. However, available evidence indicates that once a particular plant species becomes domesticated and is grown as a crop, men become involved, especially when its production is commercialized (Van Averbeke and Juma, 2006a). These wild vegetables tend to be regarded as a female food, but gender distinctions in terms of their consumption are less universal than in terms of their collection (Whitbread, 1986; Hart and Vorster, 2006).

C. olitorius is an exotic annual dicotyledonous herb that has been cultivated in India since ancient times. Commonly known as Jew's mallow or wild okra (English), *Wild jute* in Afrikaans; *thelele* and *ligusha* in Xitsonga and Shangaan (Fox and Norwood, 1982; Bromilow, 1995; Van Wyk and Gericke, 2000, Vorster et al., 2002) it is one of the wild leafy vegetables used in the Eastern Cape in South Africa. *C. olitorius* belongs to the Tiliaceae family and is an erect annual herb that varies from 20 cm to approximately 1.5 m in height depending on the cultivar. The stems are angular with simple oblong to lanceolate

leaves that have serrated margins and distinct hair-like teeth at the base. The bright yellow flowers are small and the fruit is an angular capsule. *Corchorus* seeds show a high degree of dormancy which can be broken by means of hot water treatment (Schippers et al., 2002a). It has been recorded to establish naturally from seeds and tolerates a wide range of soils and climates (Oladiran, 1986). In Botswana, attempts to encourage farmers to cultivate this plant have remained fruitless due to poor germination (Velempini et al*.,* 2003).

In South Africa, *C. olitorius* is only harvested from the wild, but it has the potential for development as a crop, particularly in the north and eastern parts of the country. Okra on the other hand is a cultivated crop, albeit on a limited scale (Khuvutlu and Laker, 1993). Many of the vegetable species including *C. olitorius*, especially those that grow as weeds or in the wild, are seasonal and highly perisha-ble. To extend the period during which they are available, different ways of preserving these vegetables have been developed. These mostly are the sun-drying of fresh leaves and the sun-drying of blanched or cooked leaves. Both these methods transform the leafy vegetables into dry products that have prolonged shelf life (Vorster et al., 2005). However, this still falls short in meeting the dem-and for fresh leaves of *C. olitorius.* Moreover, some nutri-ents may be lost during the preservation process.

In the study area natural germination of this plant begins towards the end of spring and grows throughout summer. In this experiment, *C. olitorius* seeds were germinated and seedlings were established in winter well before the onset of spring. This was done in an attempt to ensure availability of fresh leaves of the vegetable for more than one season. In the advent of recent challenges in food security, enhancing germination of *C. olitorius* for possible domestication in the study area may provide an economic and nutritious option.

MATERIALS AND METHODS

Plant collection

Seeds of *C. olitorius* were harvested from the wild within OR Tambo Municipality in the Eastern Cape. The seeds were collected within 3 weeks of their production whilst flowering was still occurring on the other branches of the plant. Plant identification was done at the Kei herbarium at Walter Sisulu University.

Tetrazolium chloride test

In ensuring that seeds utilized for the experiment were viable, a seed viability test using the tetrazolium technique (Grabe, 1970) was conducted. Three replicates of 50 seeds each were used. Using the procedure by Peters (2000), the seeds were imbibed for 24 h in water, cut along the margin without damaging the embryo and soaked in colourless 0.1% solution of 2,3,5-triphenyltetrazolium chloride (TTC) solution for 18 h at 25^{o}C in the dark (Kambizi et al, 2006). The seeds were removed from TTC solution and washed with distilled water. The seeds were then viewed under a light microscope to observe the stained embryos. Whole embryos of viable seeds appeared bright red in colour.

Germination experiment

Germination testing was done in 9-cm sterile Petri dishes lined with two Whatman No. 1 filter papers. These were moistened using distilled water, each treatment having three replicates of 50 seeds each. Prior to exposure to these conditions seeds were also subjected to prechilling for 1, 3 ½ and 7 days pre-chilling at 6^{o}C. The effect of temperature on germination was investigated by placing the Petri dishes in incubators set at 25 and 35^{o}C. Seeds were moistened with distilled water via Whitman's filter paper discs and exposed to continuous illumination from white fluorescent tubes. The Petri dishes were examined daily and seed was considered germinated when the radicle was visible. Data collected were subjected to analysis of variance with temperature and pre-chilling as treatments using Microsoft excel 2007.

RESULTS AND DISCUSSION

C. olitorius seeds utilized in the tetrazolium test yielded 90.1% viability. In many germination experiments the tetrazolium chloride test has been shown to be in close agreement with germination test results and has been mentioned for over 650 plant species (Moore, 1985; Leist and Krämer, 2003). This high percentage could be attributed to the fact that the seeds were harvested and the germination trials conducted within three weeks. To further support the high percentage obtained, it is possibly due to the use of seeds harvested and tested during the same season.

After the analysis of variance on the results, it was observed that there were significant differences between the treatments as well as the interaction between the treatments as shown by Table 1. Seeds placed at a temperature of 25^{o}C showed no signs of germination. On the other hand those placed at 35^{o}C did germinate, with the percentages ranging from 2 to 88% being the highest across all the replicates. Table 2 shows germination of *C. olitorius* seeds at two different temperatures and three different pre-chilling conditions.

Germination did not occur in any of the seeds placed at a temperature of 25^{o}C in the control and all the pre-chilled seeds. While those placed at a temperature of 35^{o}C showed signs of germination; this may possibly be due to the fact that *C. olitorius* grows well mostly when day temperatures average 30^{o}C and above. Further looking at the differences found within the seeds placed at a temperature of 35^{o}C as shown on Table 2, there is a significant difference between seeds pre-chilled for 3 ½ days and the rest. Contrary to the study that *Corchorus* seeds show a high degree of dormancy which can be broken by means of hot water treatment (Schippers et al., 2002a), in this experiment seeds subjected to pre-chilling conditions of approximately 6^{o}C showed germination. Pre-chilling has also been reported to cause lethal effects on viable seeds (Ren and Tao, 2004) while other studies have implicated cold stratification to break dormancy of viable seeds and enhance germination in many species (Baskin et al., 2001). This may have been the case with *C. olitorius* in this investigation. Results showed that seeds pre-chilled for a day and seven days had lower

Table 1. Analysis of variance of seed germination in *Corchorus olitorius.*

Source of variation	SS	df	MS	Comp F	F at 1%	F at 5%
Temperature	2562.667	1	2562.667	141.0642	8.530	4.494
Pre-chilling	5984	3	1994.667	109.798	5.292	3.239
Interaction	5984	3	1994.667	109.798	5.292	3.239
Within	290.667	16	18.167			
Total	14821.333	23				

*Significant at (P> 0.01).

Table 2. Germination of *Corchorus olitorius* seeds at two different temperatures and three different pre-chilling conditions.

Pre-chilling treatment	Temperature		
	25°C	35°C	
Untreated (Control)	0	3.33	$(4.163)^b$
Pre-chilled for 1 day	0	1.33	$(1.154)^b$
Pre-chilled for 3 ½ days	0	75.33	$(11.101)^a$
Pre-chilled for 7 days	0	0.67	$(1.154)^b$

Each value represents mean percentage germination with standard deviation in parenthesis. Means followed by the same superscript do not differ significantly (P>0.01).

germination percentages as compared to those pre-chilled for three and a half days. The trend observed shows a low percentage from one day followed by a sharp percentage spike or exponential increase for those pre-chilled for 3 ½ days, followed by a sharp decrease as the number of days increased.

However, several other experiments involving pre-chilling of seeds for plant species that grow mostly in summer have revealed that seeds pre-chilled for usually approximately 7 days have the highest germination percentages (Baskin et al., 2001). This was not the case in this experiment as the highest was observed in seeds pre-chilled for 3 ½ days. This may probably be that the pre-chilling plays a pivotal role in the number of days that will result in the highest percentage germination. If the temperature was considerably lower than 6°C then the peak percentage germination may probably be observed on different pre-chilling days than 3½. The pre-chilling treatment conditions may actually be simulating the events that occur during the winter season just before the onset of summer.

The highest average percentage germination of 75.3% is not excessively far-off the viability of 90.1% obtained from the TTC test. This may also explain the high natural regeneration, as the dormancy will be as low as 14.8% using the high germination of 75.3% and a viability of 90.1%. Nursery establishment of *C. olitorius* under the conditions investigated in this experiment may be utilized to ensure availability of its seedlings well before the onset of summer thereby lengthening the period of usage during each year and to reinforce efforts to domesticate it in the Eastern Cape, South Africa.

ACKNOWLEDGEMENT

This research was supported by Walter Sisulu University and the National Research Foundation of South Africa.

REFERENCES

Baskin CC, Milberg P, Andersson L, Baskin JM (2001). Seed dormancy breaking and germination requirements of *Drosera anglica*, an insectivorous species of the Northern Hemisphere. Acta Oecol. 12: 1-8

Bhat RB, Rubuluza T (2002). The biodiversity of traditional vegetables of the Transkei region in the Eastern Cape of South Africa. S. Afr. J. Bot 68(1): 94-99.

Bromilow C (1995). Problem plants of South Africa. Briza Publications, Pretoria, South Africa. p. 315.

Fox FW, Norwood Young ME (1982). Food from the Veld: Edible Wild Plants of Southern Africa. Delta Books, Johannesburg, South Africa. p. 399.

Grabe DF (1970). Tetrazolium testing handbook for agricultural seeds. Association of Official Seed Analysts, Contribution No. 29 to the Handbook of seed testing.

Hart TGB, Vorster HJ (2006). Indigenous Knowledge on the South African Landscape Potentials for Agricultural Development. Urban, Rural and Economic Development Programme. Occasional paper No 1. HSRC Press, Cape Town, South Africa. p. 52.

Husselman M, Sizane N (2006). Imifino. A Guide to the use of Wild Leafy Vegetables in the Eastern Cape. ISER Monograph Two. Institute for Social and Economic Research, Rhodes University, Grahamstown, South Africa.

Jansen Van Rensburg WS, Venter SL, Netshiluvhu TR, Van Den Heever E, Vorster HJ, De Ronde JA (2004). The role of indigenous leafy vegetables in combating hunger and malnutrition. S. Afr. J. Bot. 70(1): 52-59.

Jansen Van Rensburg WS, Van Averbeke W, Slabbert R, Faber M, Van Jaarsveld P, Van Heerden I, Wenhold F, Oelofse A (2007). African leafy vegetables in South Africa. Water SA Vol 33 No. 3 (Special Edition). Available from http://www.wrc.org.za.

Kambizi L, Adebola PO, Afolayan AJ (2006). Effects of temperature, pre-chilling and light on germination of *Withania somniifera* a high value medicinal plant. S. Afr. J. Bot. 72: 11-14.

Khuvutlu I, Laker MC (1993). Identifying constraints and opportunities for farmers at Middle Letaba Irrigation Project using a low cost appraisal approach. FSRE-E South. Afr. Newslett. 5. 6-16.

Leist N, Krämer S (2003). ISTA Working Sheets on Tetrazolium testing: Volume 1. Agricultural Vegetable and Horticultural Species, 1st Edn, p. 176.

Modi M, Modi A, Hendriks S (2006). Potential role for wild vegetables in household food security: a preliminary case study in KwaZulu-Natal, S. Afr. J. Food Agric. Nutr. Dev. 6(1): 1-13.

Moore RP (1985). Handbook on Tetrazolium Testing, 1st Edn, International Seed Testing Association, Zurich, Switzerland, p. 99.

Oladiran JA (1986). Effect of stage of harvesting and seed treatment on germination, seedling emergence and growth in *Corchorus olitorius* 'Oniyaya'. Sci. Hortic. 28: 227-233.

Parsons N (1993). A New History of Southern Africa (2nd edn.) Macmillan, London. p. 349.
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.
Ren J, Tao L (2004). Effects of different pre-sowing seed treatments on germination of 10 *Calligonum* species. For. Ecol. Mange 195: 291-300.
Rose EF and Guillarmod AJ (1974). Plants gathered as foodstuffs by the Transkeian peoples. Suid-Afikaanse Mediense Tydskrif 86: 1688-1690.
Rubaihayo EB (1997). Conservation and use of traditional vegetables in Uganda. In: Guarino L (ed.) Traditional African Vegetables. IPGRI, Rome. pp. 104-116.
Shackleton CM, Shackleton SE, Cousins B (2000). Revaluing the communal lands of Southern Africa: a new understanding of rural livelihoods ODI Nat. Res. Persp. 62: 1-4.
Schippers R, Maundu P, Imbuni M, Obiero H (2002a). How to grow and use Jew's Mallow. Horticultural Development Services, Baarn, The Netherlands. p. 10.
Van Averbeke W, Juma KA (2006a). The cultivation of *Solanum retoflexum* Dun. In Vhembe, Limpopo Province, South Africa. Proc.Int.Symp.on the Nutritional Value and Water Use of Indigenous Crops for Improved Livelihoods. 19-20 September 2006, University of Pretoria, Pretoria. [CD ROM]. The Center for Nutrition, University of Pretoria.
Van Wyk B, Gericke N (2000). People's Plants. A Guide to Useful Plants of Southern Africa. Briza Publications, Pretoria, South Africa pp352
Velempini P, Riddoch I, Batisani N (2003). Seed treatments for enhancing germination of wild okra (*Corchorus olitorius)*. Exp. Agric. 39: 441-447.
Vorster HJ, Jansen Van Rensburg WS, Van Zijl JJB, Van Den Heever E (2002). Germplasm Management of African Leafy Vegetables for the nutritional and Food Security Needs of Vulnerable Groups in South Africa. Progress Report. ARC-VOPI, Pretoria, South Africa, p. 130.
Vorster HJ, Jansen Van Rensburg WS, Venter SL, Van Zijl JJB (2005). (Re)-creating awareness of traditional leafy vegetables in communities. Regional workshop on African Leafy Vegetables for Improved Nutrition. Paper presented at Regional Workshop on African Leafy Vegetables for Improved Nutrition, 6-9 December 2005, IPGRI, Nairobi, Kenya (Available from ARC-VOPI, Pretoria, South Africa). p. 6.
Whitbread MW (1986). Preliminary Studies on the Utilization and Adaptation of Indigenous and Introduced Vegetables and Grain Amaranths (*Amaranthus* spp) in the Natal and KwaZulu midlands. MSc. (Agric) Dissertation. University of Natal, Pietmaritzburg. p. 54.