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RESEARCH NOTE

Efficient method for breaking seed dormancy in lamb's quarters (*Chenopodium album* L.)

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Studies on seed dormancy in lamb's quarters (*Chenopodium album* L.) var. Ooty 1 (Ck 1) revealed that the freshly harvested seed possess dormancy for about 30 days. Thereafter, the seed started to germinate minimally (2 %) and reached 100 per cent on 165 days after harvest. However, the seeds were viable (100 %) from the day of harvest upto 165 days. Therefore, the dormancy breaking treatments were imposed which effectively improves the germination of freshly harvested seeds. In which, soaking of seeds in ethrel @ 50 ppm for 18 h would overcome the physiological dormancy with the maximum germination (86 %).

Key words: Ethrel, Seed dormancy, Seed germination

Lamb's quarters (*Chenopodium album* L.) is a minor leafy vegetable, belongs to the family Amaranthaceae. It is the fast growing annual plant, grown well in tropical and sub-tropical region with soil rich in nitrogen. It is cultivated in wider range so its native is obscure. Hence, it was described by Linnaeus in 1753 from Europe, it is believed that lamb's quarters may be of European origin. This species has several subspecies, micro species as well as varieties which cannot be differentiated easily. The crop is grown for various purposes like food, fodder and also for its medicinal purpose in Asian and African countries. In India, it is highly cultivated in Northern region, where winter season is most suitable. However in South India, the people consume it as leafy vegetable.

The crop has recently gained worldwide attention due to its nutritional value. Economically, the leaves and stems are used as vegetable, either raw or cooked and the tender leaves are used in many Indian dishes. Seeds also used as food and it can be grown as a pseudo-cereal. In the Himalayan region, it is considered as an important subsidiary grain crop, as a pot herb for secondary fodder and salad dressings (Bhargava and Ohri, 2007). The leaves are rich in vitamin A and C, essential oils, minerals particularly potash and considerable amount of albuminoids and nitrogen. The root contains saponin and two flavonoids *viz*., 'kampferol' and 'quercetin'. Therefore, it is widely used in folk medicine around the world. Particularly, it is used in the treatment of rheumatism, bug bites, sun stroke, urinary problems, skin problems *etc*. Also, the plant has medicinal values like laxative property and act as blood purifier and anti-ulcer agent (Sanwal, 2008). Tamil Nadu Agricultural University (TNAU) has released a variety in Lamb's quarters (*Chakravarthi keerai*) named 'Ooty (Ck) 1'. This variety is rich in protein (22 %), zinc (23 ppm), calcium (0.84 %), magnesium (0.58 %) and iron (474 ppm).

The crop is mainly propagated through seeds. However, the heteromorphic differences were observed in seed morphology and dormancy (Williams and Harper, 1965). In which, brown seeds were large, non-dormant and more salt tolerant and germinate rapidly. Whereas, black seeds are salt-sensitive and a large proportion of seeds are dormant (Sun *et al.*, 2005; Yao *et al.*, 2010). Wang *et al.* (2008) found that the dormancy of black seeds was fluctuated according to changes in environmental condition and the dormancy may be extended over a year to maintain its population or to increase its survival rate. In this regard, Altenhofen and Dekker (2014) opined that the germination of *Chenopodium album* seeds was stimulated by interaction of light (24 h light), warm temperature (15 - 25 °C) and 0.01 M nitrate. Similarly, the incubation temperature (15 °C) and GA3 (50, 150, 250 and 350 ppm) have significantly improved the germination (Adhikary and Tarai, 2013). Therefore, the attempts were made to study the presence of dormancy in the lamb's quarters (*Chakravarthi keerai*) var. Ooty (Ck) 1 and to break the dormancy.

Genetically pure seeds of lamb's quarters (*Chakravarthi keerai*) var. Ooty (Ck) 1 were obtained from the Horticultural Research Station, Tamil Nadu Agricultural University, Ooty, The Nilgiris District. Then, the crop was raised in the field at the Department of Seed Science and Technology, Tamil Nadu Agricultural University, Coimbatore during the year 2018 - 2019. After the harvest, seeds collected were stored under ambient temperature (30 °C temperature and 70 % relative humidity) and evaluated its germination and viability by tetrazolium test at 5 days interval. In which, the seeds were preconditioned by soaking in water for 24 h. Then, the seeds were bisected longitudinally into two halves and soaked in one per cent 2, 3, 5 triphenyl tetrazolium chloride solution and kept in dark for 1 h at 40 °C for staining. After staining, the number of viable embryos were counted, viability per cent calculated and then, the mean value was expressed in percentage (Lakon, 1949).

Further, an experiment was conducted to break the dormancy by imposing following treatments *viz*., T_1 - untreated control; T_2 - soaking in water for 18 h; T_3 - sulphuric acid scarification for 4 min.; T_4 - sulphuric acid scarification for 6 min.; T_5 - cold stratification (4 °C) for 4 weeks; T_6 - cold stratification (4 °C) for 6 weeks; T_7 - soaking in thiourea @ 0.5 % for 18 h; T_8 - soaking in thiourea @ 1.0 % for 18 h; T_9 - soaking in gibberellic acid @ 100 ppm for 18 h; T_{10} - soaking in gibberellic acid @ 200 ppm for 18 h; T_{11} - soaking in ethrel @ 50 ppm for 18 h; T_{12} - soaking in ethrel @ 100 ppm for 18 h; T_{13} - soaking in potassium nitrate @ 0.5 % for 18 h and T_{14} - soaking in potassium nitrate @ 1.0 % for 18 h. After imposing the treatments, germination test was conducted as per the ISTA (2020). Then, the speed of germination was calculated by using the formula (Maguire, 1962). The vigour index was calculated by multiplying the germination percentage and seedling length (Abdul-Baki and Anderson, 1973). The data collected were

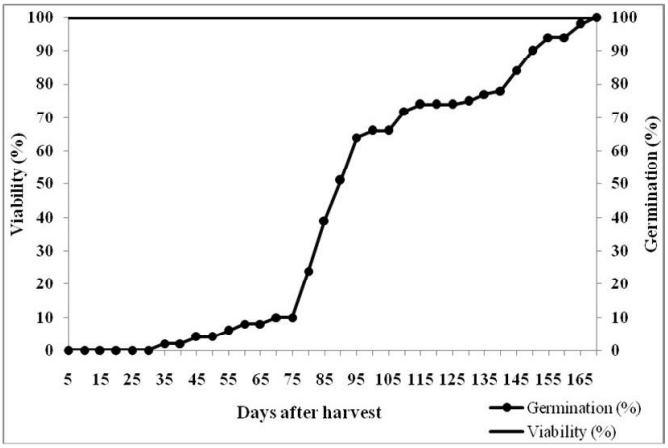

Fig. 1. Periodical evaluation of germination and viability of freshly harvested seeds of lamb's quarters (*Chakravarthi keerai*) var. Ooty (Ck) 1

subjected to statistical analysis (Panse and Sukhatme, 1967) and the critical difference values were calculated at 5 % probability level.

The freshly harvested seeds failed to germinate under favourable condition for the period upto 30 days. However, the tetrazolium test recorded 100 per cent viability confirms the presence of dormancy in the seeds. The seeds started to germinate (2 %) on 30 days after harvest (DAH) and reached maximum (72 %) on 105 DAH as per the requirement of Indian Minimum Seed Certification Standards. However, the seeds continued to release its dormancy and attained 100 per cent germination indicating 100 per cent viability of seeds up to 165 days (Fig. 1). Similar studies on the dormancy were reported by many scientists (Williams and Harper, 1965; Sun *et al.*, 2005; Wang *et al.,* 2008; Yao *et al.*, 2010). Machabee and Saini (1991) found that the presence of primary dormancy in chenopodium is due to physiological inhibiting mechanism. This inhibiting mechanism is mainly due to the presence of high level of inhibitors (abscisic acid) and low level of growth promotors (ethylene and gibberellins). In this regard, the primary dormancy was resolved by exposure of dry seed to high temperatures (after- ripening) (Bewley and Black, 1985). This might be reason for chenopodium in which the seeds started to release the dormancy at 30 DAH but it needs some more time for complete elimination of dormancy. However, the dormancy breaking treatments are essentially required for getting higher germination at immediate use.

Among the treatments, soaking the seeds in ethrel @ 50 ppm for 18 h recorded significantly higher germination (86 %), speed of germination (6.1), shoot length (4.6 cm), root length (4.2 cm) and vigour index (757) compared to control (Table 1). Similar results were reported in chenopodium (Saini *et al.*, 1985; Goudey *et al.*, 1987) and amaranthus (Kepczynski *et al.,* 1996, Birua, 1997). Further, treating chenopodium seeds with a combination of cold stratification and solid matrix priming resulted increased germination percentage (Hock *et al.*, 2006). Incubation temperature (15 °C) and treatment with GA3 (350 ppm) (Adhikary and Tarai, 2013) and interaction of light (24 h light), warm temperature (15 - 25 °C) and 0.01 M nitrate treatment (Altenhofen and Dekker, 2014) have significantly improved seed germination in chenopodium.

In dormant seeds, abscisic acid (ABA) was found to inhibit ethylene production and germination. Therefore, growth of dormant embryonic axis and cotyledon was improved by exogenous application of ethylene (Edgerton and Blanpied, 1968; Ketring and Morgan, 1970; Satoh and Esashi, 1980). Thus, the increase in germination and seedling vigour in chenopodium might be due to ethylene interaction with growth inhibitor (abscisic acid), growth promotor (gibberellin) and also involve in enzyme synthesis (α- amalyse) (Ketring, 1977; Matilla, 2000). In addition, ethylene production results in accumulation of 1-aminocyclopropane-1-carboxilic acid (ACC) which accompanied with improved activity of endo β - mannanase, a cell-wall enzyme

Table 1. Effect of dormancy breaking treatments on germination and seedling vigour in lamb's quarters (*Chakravarthi keerai)* var. Ooty (Ck) 1

Treatments	Speed of germination	Germination (%)	Shoot length (cm)	Root length (cm)	Vigour index
T_1 - Control	0	0 (2.86)	0	0	0
T_2 - Water soaking for 18 h	1.4	19 (25.84)	3.0	2.4	106
T_3 - H_2SO_4 scarification for 4 min.	1.6	9 (17.45)	3.1	2.6	51
T_4 - H_2SO_4 scarification for 6 min.	1.0	11 (19.37)	3.3	2.9	59
T_5 - Cold stratification for 4 weeks	1.2	9 (17.45)	3.4	3.0	56
T_6 - Cold stratification for 6 weeks	0.9	8 (16.43)	3.2	2.5	48
T_7 - Thiourea @ 0.5% for 18 h	3.9	52 (46.14)	3.6	3.6	369
T_8 - Thiourea @ 1% for 18 h	5.7	61 (51.35)	3.2	3.2	368
T_9 - GA_3 @ 100 ppm for 18 h	1.8	27 (31.30)	3.7	3.5	180
T_{10} - GA_3 @ 200 ppm for 18 h	2.6	31 (33.83)	3.9	3.4	190
T_{11} - Ethrel @ 50 ppm for 18 h	6.1	86 (68.02)	4.6	4.2	757
T_{12} - Ethrel @ 100 ppm for 18 h	5.9	80 (63.43)	4.1	3.8	628
T_{13} - KNO_3 @ 0.5% for 18 h	3.4	57 (49.02)	3.3	3.4	344
T_{14} - KNO_3 @ 1% for 18 h	4.5	40 (39.23)	3.1	2.9	300
S.Ed. 0.05	4.4	0.7	0.5	47.8	
C.D. (P=0.05)	0.10	9.5	1.5	1.2	102.5

(Figures in parentheses indicted arc sine transformed values)

that weakens the endosperm and allows seed to germinate and also related to amino acid accumulation in seeds (Esashi *et al.*, 1996; Nascimento, 2003).

It can be concluded that the chenopodium seed possess dormancy upto 30 days and takes about 165 days for its complete elimination. Hence, the fresh seeds can be treated with ethrel @ 50 ppm for 18 h to release the dormancy and get maximum germination (86 %).

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