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Seed Biology of an Invasive Weed–*Euphorbia geniculata* Ortega from North-west Himalaya (India)

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ABSTRACT

Explosive seed dispersal, viability and germination in *Euphorbia geniculata* have been determined. Plant disperse seeds explosively upto 6 m but dispersal was affected by temperature, humidity and radiation load. Seed viability was not affected by dry storage (X±SE=93.6±0.67) and low temperature (X±SE= 9I.6±0.7). Seeds lacked primary dormancy, however, low temperature enforced secondary dormancy. Seed dispersal began at 1100 h and finished at 1500 h with peak at 1300 h (52.3%) during September. During November when temperature drops, dispersal began at 1100 h and finished at 1400 h with peak at 1200 h (40.7%). However, there was no significant correlation between temperature and seed dispersal. The distance peak of explosively dispersed seeds was observed between 100-200 cm (26%) and tail of distribution reached upto 677 (X±SD=243.6±148.8) cm and dispersal distance was not dependent on seed weight.

Key words : Explosive seed dispersal, *Euphorbia geniculata*, weed biology

INTRODUCTION

Annual weeds have a reproductive strategy that enables them to overcome various hinderances posed by environmental conditions during life cycle. A timely concurrence with these conditions is necessary for successful establishment. Various factors which determine their successful persistence are prolonged seed viability, large seed bank, effective seed dispersal and pattern of germination. In seeds of majority of weeds, primary dormancy is lost during burial and seasonal pattern of germination is due to environmental conditions that constraint germination (Stroller and Wax, 1973; Reisman-Berman *et al.*, 1991).

Euphorbia geniculata is a troublesome weed of Neotropical origin, produces upto four generations per year (Dafni and Karneili, 1979) with higher regeneration potential and seed set (Kigel *et al.*, 1992) poses major threat to the local flora. In India, the species was introduced in 19th centaury (Mayurnathan, 1934) and now it is major weed of economically important crops like cotton, soybean (Mishra and Singh, 2000, 2003; Mishra *et al.*, 2003), coffee (Mayurnanthan, 1934), maize, fodder crops as well as roadside weed in North-West Himalaya. Keeping this in view, the biology of seeds of *Euphorbia geniculata* was worked out.

MATERIALS AND METHODS

Study Site

The study was carried out between 2004-06 at Jammu (North-West Himalaya, India) which lies 32º 45' N latitude and 74º 55´ E longitude. The altitude ranges from 300-800 m (m. s. l.). Climate of the region varies from sub tropical to arid, overall vegetation is dry, mixed deciduous or scrub type (Sharma and Kachroo, 1981).

Seed Dispersal

Ripe capsules were marked during morning hours which were monitored for seed dispersal after every hour as per methods described by Narbona *et al.* (2005). The census was conducted between 1000-1500 h for 10 days (six and four days during September and November, respectively). Per hour shade temperature was also recorded.

Dispersal Distance

Entire above ground branches of *E. geniculata* bearing mature fruits were placed in a container of water as per the method given by Narbona *et al.* (2005), which were kept in the centre of open space. The experiment was repeated on four sunny and windless days. When

maximum dispersal of mature fruit was achieved, distance of individual seed was determined.

Seed Weight and Size

Seeds were kept in vials (n = 150 seeds) for determining weight and size. Seed size was determined using stereoscope equipped with ocular micrometer as mentioned by Garrison *et al.* (2000). Seed weight was determined on electro balance in the laboratory.

Seed Viability and Germination

The viability of seeds was determined by Tetrazolium topography (Tz) test. Pre-soaked seeds (n = 50 seeds) were split into two identical halves after removing seed coat. One of the halves with embryo was kept in TTC (l %) solution under dark for about 2 h at 30°C. Then samples were observed to interpret results.

Seed germination was studied under laboratory conditions. The seeds were collected and divided in two batches, one of them kept at 5°C for 90 days. The other was stored under dry condition for eight months. After treatment, the seeds from both chilled and unchilled were divided into samples of 50 seeds (6 and 10 samples, respectively) which were treated with 0.1% mercuric chloride for 5 min followed by wash with 70% alcohol for 2 min and subsequently rinsed thoroughly with water till all traces of mercuric chloride and alcohol were removed. The seeds were placed on moist filter paper for germination at room temperature. The percentage germination was determined by formula.

$$\text{Percentage seed germination} = \frac{\text{No. of seeds germinated}}{\text{Total number of seeds}} \times 100$$

RESULTS AND DISCUSSION

Seed Dispersal

In *E. geniculata*, seeds were explosively dispersed. During seed dispersal, fruits became vertical from pendulous position with loss of moisture contents. Seed dispersal began at 1100 h and finished at 1500 h with peak at 1300 h (52.3%) during September (Fig. 1). During November when temperature drops, dispersal began at 1100 h and finished at 1400 h with peak at 1200 h (40.7%) (Fig. 2). However, there was no significant correlation between temperature and seed dispersal.

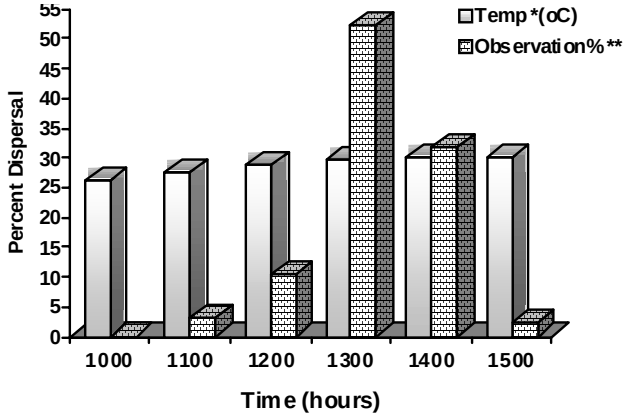

Fig. 1. Per cent dispersal rate per hour of capsules in *E. geniculata* during September for six days census.

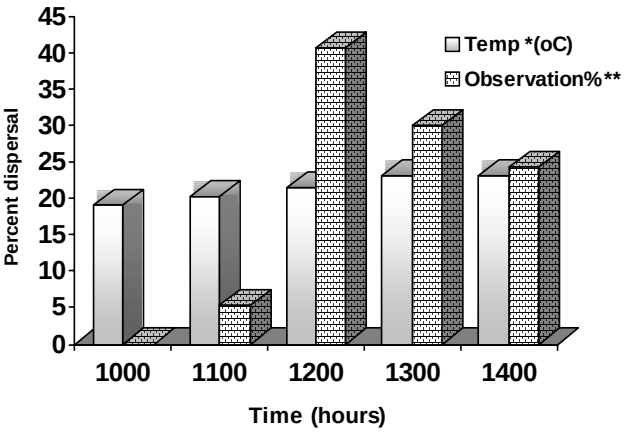

Fig. 2. Per cent dispersal rate per hour of capsules in *E. geniculata* during November for four days census.
*Mean temperature.
**Mean observation.

Dispersal Distance

The distance peak of explosively dispersed seeds was observed between 100-200 cm (26%) and tail of distribution reached upto 677 cm (X±SD=243.6±148.8) and dispersal distance was not dependent on seed weight (Fig. 3).

Seed Weight and Size

Seeds weight (X±SE=0.0092±0.01 g) and length and breadth were X±SE=0.267±0.02 and X±SE=0.266±0.01 mm, respectively.

Seed Viability and Germination

Seed viability was X±SE=86.l±0.02%. Seeds started germination on second to third day of planting. Percentage seed germination in unchilled samples ranged

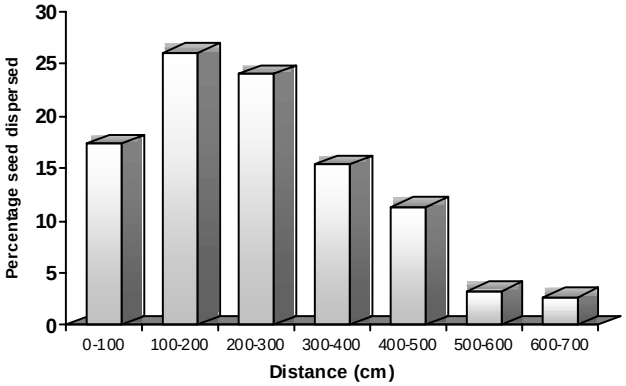

Fig. 3. Distance attained by seeds after explosive dispersal in *E. geniculata.*

from 88-98 % (X± SE=93.6± 0.67). Out of 50 seeds, the number of seeds germinated ranged from 44-49 (X± SE=45.8± 0.77) and seed germination exhausted after X±SE=4.8±0.30 days, whereas percentage seed germination in chilled samples ranged from 84-98% (X ±SE=9I.6±0.7) and the number of seeds germinated ranged from 42-48 (X±SE=45.8±0.2) and exhausted after X± SE=3.5±0.5.

CONCLUSIONS

Seeds in *E. geniculata* were explosively dispersed which is advantageous for the species to extend its habitat. During dispersal various abiotic factors play prominent role. Temperature helps in drying capsules which leads to rupture of capsule vertically thus allowing autochory. Other conditions like radiation load, humidity and vegetation at the time of dispersal are equally important (Garrison *et al.*, 2000; Narbona *et al.*, 2005*).* By this method, plant can expel seeds equal to seeds dispersed by ants in other species (Espadaler and Gomez, 1996, 1997, 2000; Gomez and Espadaler, 1994, 1998; Narbona *et al*., 2005*).* Seeds lack primary dormancy thus able to germinate immediately on release but depend on the moisture availability and temperature. Seed viability was not affected by low temperature and able to germinate after a dry storage of eight months.

The strong regeneration potential (Kigel *et al.*, 1992) coupled with high seed output, lack of primary dormancy, large seed bank and explosive dispersal aid the species in colonizing new habitats. However, its seed bank can be easily depleted by tilling and flushing the land with water prior to sowing alongwith chemical spray (Kleifeld *et al.*, 1979).

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