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Studies on seed and seed germination biology of *Lepidium sativum* Linn. as influenced by various factors

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Abstract

Germination is the awakening of the dormant embryo. As soon as the necessary conditions are satisfied the embryo awakens and the phenomenon of germination begins. Germination mechanism plays an important role in the autecology of a species. *Lepidium sativum* Linn. commonly known as Chansur (H) and Garden cress (E) possess various medicinal values was selected for present investigation to report the seed and seed germination biology. Various factors were selected to investigate the germination profile.

Key-Words: Seed, *Lepidium sativum*, Germination

Introduction

Lepidium sativum Linn. belongs to family Brassicaceae is an important cash crop, mainly cultivated for its seeds, which possess medicinal and economic value. It is commonly grown in some parts of our country in the month of October-November and harvested in February-March.¹

Cultivation of medicinal plants is generally practiced by the traditional farmers on marginal lands. They are apart from the modern agro techniques. Hence, they are getting the financial gain. Hence, the improve cultivation of medicinal plants of such land is present day need to utilize the existing limited resources with the farmers and to rise their socio-economic status.² Despite, the usefulness and importance of the species, accurate information on seed germination biology is not available, Therefore, the plant was selected for present investigation.

Material and Methods

Morphology of Seeds

Morphology of seeds was studied by illustrating its macroscopic parameters.³

Seed weight

10 lots of 1000 seeds were weighed separately with the help of chemical balance and an average weight of a single seed was calculated.

Seed volume

A lot of 1000 seeds were immersed in measured quantity of water, kept in measuring cylinder and the water displaced so was calculated to be equal to the volume of 1000 seeds. In 10 replicates, average volume of a single seed was calculated.

Germination Strategies and Seedling Growth

Germination initiation

The days required for emergence of radicle from the date of sowing of seeds is known as germination initiation. It is measured in days.⁴

Germination speed

Germination speed was calculated as per method suggested by Pandey⁴. It is refer is days within which 50% seeds undergo germination.

Germination percentage

The germination percentage is the proportion of seeds that germinate from all seeds subject to the right conditions for growth. There is great variation amongst plants and a dormant seed is still a viable seed even though the germination rate might be very low. Germination percentage can be calculated by the formula given below⁵.

$$\text{Germination \%} = \frac{\text{Total number of seeds germinated}}{\text{Total number of seeds sown}} \times 100$$

Seedling growth

Seedling growth is the total length of radicle and plumule after the germination of seeds. The length of radicle and plumule was recorded after seven days and the length of seedling growth is mentioned in cm⁵.

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Effect of various factors like ageing, soil depth, soil types, watering conditions, range of temperature etc. were studied^{6,7} as per methods cited below and included in the text.

Effect of ageing on seed germination and viability of seeds

To study the effect of ageing of seed germination and seedlings growth, seeds were harvested on 10.03.2008 and assumed as 0 month old. To study the effect of age factor on seed germination and longevity of seeds, the 0 month old 50 seeds in three replicates, were set for germination on the same date. Similar studies were done on same dates of each subsequent month. The experiment was discontinued on 30.03.2009, after that the seed germination was practically became nil.

Seed germination in varying soil depths

For proper germination of seeds depth of seed sowing is very important and relevant factor. To find out a proper depth of seed sowing for better seed germination the present experiment was done. 50 seeds were sown in polythene bags with varying depths of soil as shown below and the data pertaining to germination behaviour and seedling growth were recorded and mentioned in the text.

No. of Bag	Depth of Soil (cm)
1	0
2	1
3	2
4	3
5	4

Seed germination in different types of soil

Soil plays a very important role in the growth of plants. Different types of soil were collected and filled in pots, maintaining sufficient soil moisture. Three samples of each soil type were prepared in pots and 50 seeds in each pot were sown for germination and results were recorded in Black soil, Garden soil, Municipal manure (FYM), Garden soil + FYM, Garden soil+ FYM + Black soil.

Effect of different watering regimes

Three earthen pots of equal size were taken and filled with equal quantity of garden soil and 50 seeds were sown in each pot. Each pot was irrigated with 2 liter of water by maintaining following condition as: Water logged, Daily watering, Alternate day watering, 3 rd day watering and 4 th day watering.

Effect of photosensitivity on seed germination

To study the effect of photosensitivity on seed germination, petridishes were filled with experimental soil and in each pot 50 seeds were sown. The petridishes were placed as under and germination

percentage and seedling growth were recorded in Bright light (as control), Room shade, Total darkness and Tree shade.

Effect of monochromatic light

Arranged the seeds in petri -dishes and the dishes were covered with blue, green, yellow and red cellophane paper to obtain the monochromatic light. One set remained in natural light and it is treated as control. The data recorded as per method suggested by Evenari and Neumann⁸ and Pandey⁹. The replicates were statistically analyzed and mentioned in the text.

Range of temperature

Fifty seeds were sown in petri-dishes between cotton pad and moist filter paper, in each temperature range, viz., 5-10, 10-20, 20-30 and 30-40°C. Three replicates were recorded, as per method suggested⁹. Replicates set were put for statistical analysis of any difference.

Results and Discussion

The seed and seed germination

Morphologically the seed consist of an embryo surrounded by testa. In comparison to spores the seed could carry much larger food reserves and being multicellular tends itself to elaborate adaptation giving better temperature. In the life cycle of seed plants, germination is an important and crucial phase. Different species have varied germination needs and this expresses adaptation of the species and the seeds so that it can cope with environmental conditions. As soon as the required conditions are fulfilled the embryo awakens and phenomenon of germination occurs.

Morphology of Seeds

Seed characters actually originate due to interaction of various environmental conditions prevailing in the habitat of plant. These are correlated with the survival and dispersal of the species, traced that morphology of seeds is an important characters in assessing the mode an extent of dispersal of species. Seeds were collected from different study sites related at random and were taken for morphological studies.

Seeds Weight

10 lots of 1000 seeds were taken for the measurement of seed weight. The seeds in each lot were selected on a random basis from the experimental field. Every lot was weighed with the help of digital single pan chemical balance and readings were noted down. The seed weight of *Lepidum sativum* (for 1000 seeds) ranges from 1.425 gm to 2.148 gm. Average weight of one seed calculated and mentioned in table 1.

Seeds Volume

To measure the seed volume, water displacement method has been used. 10 lots of 1000 seeds were taken on random basis from experimental field. The seed volume was measured and shown in table 1.

Table 1: Seed weight and seed volume of *Lepidium sativum*

S/No.	Seed Weight (gm)	Seed Volume (ml)
1	1.552	0.3
2	2.116	0.6
3	1.463	0.3
4	1.785	0.5
5	2.148	0.6
6	1.797	0.5
7	1.931	0.5
8	2.113	0.6
9	1.425	0.3
10	1.860	0.5
Total	18.190	4.7
Mean	1.819	0.47
X± SD	1.819 ± 0.8	0.47 ± 0.3

Weight of 1 seed = 0.001819 gm, Volume of 1 seed = 0.00047 ml

Seed Germination and Seedlings Growth

Effect of ageing on seed germination and viability of seeds

Table 2 reveals the germination initiation, germination speed, germination percentage, seedlings growth and viability of seeds of *Lepidium sativum*. It was observed that freshly collected seeds showed poor germination

behaviour. Likewise, the same condition was noted in older seeds. However, a great variation in germination behaviour and seedlings growth was observed in subsequent months and best germination percentage was recorded in 7-10 months old seeds. The seeds of this species remained viable for a period of 19 months.

Table 2: Effect of ageing on germination initiation, germination speed, germination percentage, seedlings growth and viability of seeds of *Lepidium sativum*.

Months	Age (month)	G.I. (days)	G.S. (days)	G.P. (%)	Seedling growth (cm)		
					Radicle	Plumule	Total
Mar'08	0	10	0	36±2.8	1.4	1.2	2.6
Apr'08	1	08	0	38±2.5	1.5	1.3	2.8
May'08	2	07	0	40±2.6	1.6	1.3	2.9
Jun'08	3	07	0	44±3.2	1.6	1.3	2.9
Jul'08	4	06	10	52±3.5	1.8	1.4	3.2
Aug'08	5	06	11	58±2.8	1.8	1.5	3.3
Sep'08	6	03	12	62±2.5	1.9	1.5	3.4
Oct'08	7	04	07	86±1.5	2.0	1.5	3.5
Nov'08	8	05	08	82±1.6	2.0	1.4	3.4
Dec'08	9	08	10	80±2.0	1.7	1.3	3.0
Jan'09	10	10	12	78±2.5	1.5	1.3	2.8
Feb'09	11	10	11	76±2.3	1.5	1.2	2.7
Mar'09	12	08	10	72±2.1	1.3	1.1	2.4
Apr'09	13	08	09	70±2.6	1.3	1.0	2.3
May'09	14	09	09	64±2.3	1.2	1.0	2.2
Jun'09	15	09	08	52±2.5	1.2	0.7	1.9
Jul'09	16	10	0	46±2.0	1.0	0.5	1.5
Aug'09	17	12	0	30±2.5	0.8	0.4	1.2
Sep'09	18	14	0	20±1.5	0.5	0.3	0.8
Oct'09	19	14	0	10±1.8	0.5	0.3	0.8
Nov'09	20	0	0	0	0	0	0

GI= Germination initiation, GS=Germination speed, GP=Germination percentage

Effect of varying depth of soil on seed germination

To study the varying soil depth on seed germination of *Lepidium sativum*, 7 months old seeds were taken, which showed maximum germination. Among these, 50 seeds were shown at different soil depth (0-5cm) and irrigated regularly to maintain the sufficient moisture. The data mentioned in table 3 shows that seeds do not germinate beyond the soil depth of 4 cm.

At the surface level same result was observed. However, few seeds germinate at this level. Maximum and best germination percentage and seedling growth was observed at 2 cm soil depth, while minimum germination and seedling growth was observed at 4 cm soil depth. It is evident from the table that 2 cm soil depth is better for germination and seedling growth for the species under study.

Table 3: Seed germination of *Lepidium sativum* in varying soil depth

Depth of Sowing (cm)	GI (days)	GS (days)	GP (days)	Seedling growth (cm)		
				Radicle	Plumule	Total
0	4	-	10±2.4	1.6	1.1	2.7
1	5	8	52±2.6	1.8	1.0	2.8
2	7	10	82±2.5	1.9	1.1	3.0
3	9	13	64±2.0	1.3	1.0	2.3
4	10	--	16±2.2	1.2	0.8	2.0
5	-	-	-	-	-	-

GI= Germination initiation, GS=Germination speed, GP=Germination percentage

Seed germination in different types of soil

Seeds of *Lepidium sativum* were sown in petri-dishes filled with different type of soil, viz., black soil, garden soil, farm yield manure, garden soil + farm yield manure, garden soil + farm yield manure + black soil and the emergence of seedlings were observed. Fifty seeds were sown in each replicates. The results obtained are mentioned in table 4. It is obvious that

germination percentage and seedlings length were minimum in black soil and maximum in mixture of garden soil + farm yield manure + black soil. Remaining soil types more or less showed similar germination behaviour. However, for the best germination performance of the species a mixture of all three type of soil was suitable.

Table 4: Seed germination and seedling growth of *Lepidium sativum* in different type of soil

Soil type	GI (days)	GS (days)	GP (days)	Seedling growth (cm)		
				Radicle	Plumule	Total
Black soil	7	10	52±2.6	1.5	0.8	2.3
Garden soil	5	09	68±3.8	1.6	0.8	2.4
FYM	4	08	76±2.5	1.7	1.0	2.7
GS + FYM	8	11	64±3.2	1.6	1.0	2.6
GS + FYM +BS	6	08	86±2.8	2.0	1.1	3.1

GI = Germination initiation, GS=Germination speed, GP=Germination percentage, FYM =Farm Yield Manure, GS = Garden Soil, BS = Black Soil

Effect of different watering regimes

Effect of moisture on seed germination of *Lepidium sativum* was studied by sowing 50 seed in polythene bags. The sets were watered daily, alternate day, 3 rd day and 4 th day watering. One set remained for water logged condition. Data presented in table 5 shows that

maximum seed germination was observed in alternate day watering. Likewise, the daily watering also showed better germination performance. The other watering conditions were not showed appreciable results and the water logged condition had got adverse effect on seed germination of the species under study.

Table 5: Effect of different watering regimes on seed germination of *Lepidium sativum*

Watering conditions	GI (days)	GS (days)	GP (%)	Seedling growth (cm)		
				Radicle	Plumule	Total
Water logged	3	-	4±2.4	1.2	0.6	1.8
Daily watering	4	8	78±3.2	1.5	1,	2.5
Alternate day	4	7	86±2.5	2.1	1.i	3.3

3 rd day	6	9	64+3.4	1.2	0.7	1.9
4 th day	9	-	36+3.4	1.0	0.5	1.5

GI = Germination initiation, GS=Germination speed, GP=Germination percentage

Effect of photosensitivity on seed germination

Different light conditions have got direct influence on seed germination. To see the effect of photosensitivity on germination behaviour and seedling growth of *Lepidium sativum*, water soaked seeds were set in petri-dishes and different light condition such as total darkness, room shade, partial light, bright light were given. For total darkness dark room, for room shade

normal room light and for partial light tree shades were used. Different light shades produce uncommon effects on germination and seedling growth. The results mentioned in table 6 reveals that the plant showed maximum germination percentage and seedling growth in room shade followed by tree shade. However, the seed germination in total darkness and bright light was not appreciable and it was practically nil in bright light.

Table 6: Effect of photosensitivity on seed germination of *Lepidium sativum*

Light shades	GI (days)	GS (days)	GP (days)	Seedling growth (cm)		
				Radicle	Plumule	Total
Total darkness	6	-	38+2.8	1.7	0.9	2.6
Room shade	4	8	86+3.2	1.9	0.8	2.7
Tree shade	5	8	72+3.4	1.8	0.7	2.5
Bright light	6	10	12+2.5	1.5	0.5	2.0

GI = Germination initiation, GS=Germination

speed, GP=Germination percentage

Effect of monochromatic light on seed germination

To study the effect of monochromatic light having different wavelengths, the water soaked seeds were set in petri-dishes and the dishes were covered with blue, green, yellow and red coloured cellophane papers. One set remained as control. The data mentioned in table 7

indicates that red light stimulates the seed germination and seedling growth of *Lepidium sativum*, while green light has got inhibitory effect. Meanwhile, white light treated as control had showed the maximum percentage of seed germination. Moreover, the germination behaviour in blue and yellow light were more or less similar in the plant under investigation.

Table 7: Effect of monochromatic light on seed germination of *Lepidiumsativum*

Light condition	GI(days)	GS (days)	GP(days)	Seedling growth (cm)		
				Radicle	Plumule	Total
White (Control)	3	7	88+3.5	1.9	1.0	2.9
Blue	4	8	58+3.2	1.6	0.6	2.2
Green	5	9	42+2.4	1.5	0.5	2.0
Yellow	6	10	62+3.8	1.5	0.7	2.2
Red	5	9	82+2.7	1.8	0.9	2.7

GI = Germination initiation, GS=Germination speed, GP=Germination percentage

Range of temperature

Temperature has played a vital role on seed germination of many species. Indeed, the seeds of numerous plants have a specific temperature for its seed germination. However, alternation of low and high temperature has been found to be more suitable for some species (Cohen, 1958, Pandey, 1992). Table 5.8 and figure 5.6 represents the range of temperature

for seed germination of *Lepidium sativum*. The results reveal that germination percentage and seedling growth of seeds at the range of low (5-10°C) and high temperature (30-40°C) were not appreciable. The maximum germination was recorded at the range of 20-30°C. It is also evident from the present investigation that lower and higher temperature inhibits the seed germination.

Table 8: Effect of range of temperature on seed germination of *Lepidium sativum*

Temp. range (°C)	GI(days)	GS (days)	GP(days)	Seedling growth (cm)		
				Radicle	Plumule	Total
5-10	10	-	38+2.5	1.4	0.5	1.9
10-20	4	8	72+3.4	1.8	0.8	2.6
20-30	5	9	86+2.8	1.9	1.0	2.9
30-40	6	10	52+3.5	1.6	0.7	2.3

GI = Germination initiation, GS=Germination speed, GP=Germination percentage

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