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SEED GERMINATION MATRIX IN RAUVOLFIA SERPENTINE (L.) BENTH

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Short Profile
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ABSTRACT:
In India, Sarpagandha is an important medicinal plant widely found in the foot-hills of Himalayas. Medicinal plants are valuable natural resources. Unplanned development and over-exploitation of medicinal plants from natural resources have not only resulted in paucity of various herbs, but the extinction of several species in nature. In order to meet the growing demand for the plants, it becomes important to conserve the plant species for their sustainable use. Emphasis should be laid upon cultivation of wild forms, rather than collecting from the wild as it also ensures botanical identity, genetic improvement, quality and continuity in supply. Such cultivation requires seed high percentage of seed germination. Seed germination in Rauwolfia is highly variable. The present paper reflects some seed germination attributes of Rauwolfia serpentina (L.) Benth.

KEYWORDS
Rauvolfia serpentine; Seed Germination; Medicinal plants

INTRODUCTION

Rauvolfia serpentina (L.) Benth ex Kurz (Apocynaceae) is a well known one of the most important native plants of Indian medicinal vegetation wealth. Out of 100 species in the genus found in the world, only five are available in India (Kaushik and Dhiman, 1999). These are Rauvolfia serpentina Benth., R. micrantha Hook., R. beddomei Hook., R. densiflora Benth., and R. tetraphylla Linn. In India, commonly called as Sarpagandha, almost found throughout the country and is widely distributed in the foot-hills of Himalayas, up to the elevation of 1300-1400 m.

R. serpentina grows in a wide variety of soils from sandy alluvial loam to red lateritic loam. In its natural habitat, it prefers clay or clayey loam with a large percentage of humus. Clay-loam to silt-loam soils, rich in organic contents is suitable for its commercial cultivation. According to Mathur and Singh (1965), the best soil found for the cultivation of R. serpentina is loamy or sandy clay loam and can be raised by seeds. The plant requires slightly acidic to neutral soils for good growth with medium to deep well drained fertile soils. The ideal pH for this crop is from 4.6 to 6.2. Further, it can be grown under a wide range of climatic conditions. It flourishes in hot, humid conditions and can be grown both in the Sun and in partial shade but cannot tolerate full open sun. In the nature, the plant thrives under the shade of forest trees. It prefers tropical or subtropical belt having the benefit of monsoon rains (rainfall ranging from 250-500 cm).

The roots of this plant have been used in India from ancient times. A few drugs have attracted much worldwide attention as the root of R. serpentine due to its efficacy in reducing high blood pressure and also to its well-marked sedative properties. It is used for treating various central nervous system disorders. The roots of the plant have been in use in India since long as hypnotics and sedatives in diseases like insomnia, schizophrenia, epilepsy, stress, anxiety and depression. Extracts of the roots are valued for the treatment of enteric disorders, particularly dioarrhoea and also as anthelmintic. It is also used for the treatment of cholera, colic pains and fever. The juice of the leaves is applied for removal of opacities of the cornea (Kaushik and Dhiman, 1999). Some reports have tried to link breast cancer with Rauvolfia derivatives as a curative medicine.

The collectors of crude drugs have ruthlessly extracted the plant without any consideration for its regeneration, which resulted in its extermination in certain areas. And there is every possible danger of the plant becoming extinct in its wild state.

The demand for the roots, particularly from foreign countries is far greater than the available supply from Indian forests. Since, R. serpentina roots, available from natural/wild sources are insufficient to meet with the increased demand that has risen, augmentation of supplies through cultivation is advocated. One of the major difficulties of medicinal plants cultivation in large scale is the lack of scientific and appropriate agro technology for varied climatic zones of the country. Although, several organizations viz., Indian Council of Agricultural Research, Council of Scientific and Industrial Research Laboratories, various Indian Universities, etc. and Research Councils of indigenous systems of medicine, Department of Indian System of Medicine and Forest Research Institute. Govt. of India, have taken up the work of development of appropriate agro technologies and development of high yielding varieties of medicinal plants, but much efforts are yet to be made keeping in view the demands of trade and industry.

R. serpentina can be propagated by seed and also by vegetative means like root cuttings, stem cuttings and root stems. Commercially, the plants are propagated by seeds because the optimum yield of roots is obtained. Seed germination in Rauvolfia is highly variable. It is reported to vary from 5 to 30 percent (Shetty et.al., 2014), 10 to 50 percent (Badhwar, et. al., 1955a; Jarayal, 2004; Rajesh et. al., 2005) even when only heavy seeds are chosen for sowing purpose. Light and heavy seeds can easily be separated by simple water flotation. The problem of poor germination is forcing the farmers to use cuttings for propagation.

Once R. serpentina was occurred in abundance in certain forest areas of India but due to its wild and less frequent occurrence, (Srivastava and Jha, 2002) very scanty information is available regarding agronomical technique. Some works have been carried out on the propagation techniques (Badhwar, et. al., 1955a; 1955b; 1963; Mathur, 1965 and Koerber and Reinharti, 1966) including production of synthetic seeds (Faisal et. al., 2012). Kaul (1955) reported that soil is a great factor affecting the growth and occurrence of the plant. Sobti et. al. (1959) recommended that propagation by seeds has been found to be the only suitable practical method for large-scale cultivation.

Therefore, a study was conducted to know the seed germination percentage and related characteristics of R. serpentine.

METHODOLOGY

For the present study, experimental method was used with randomized block design (factorial). Seeds of R. serpentina were collected from 'Champion Block' of Forest Research Institute, Dehradun during the period between July and November 2002. Only one provenance was chosen for collection of seeds to avoid any variation in characters. It has been found that only few fruits ripen at a time and if they are not collected immediately, they fall on the earth. Therefore, ripen fruits were collected weekly (fig.-1). Collected seeds were of two types single and didynamous (double united). Total 3000 ripen seeds were collected. After collection, the seeds were mashed gently by hand in the water to remove their pulpy covering. The clean seeds were thoroughly dried (fig.-2) in shed and stored in airtight containers after weighing. Dried seeds were dipped in water for one hour and stirred with a stick to remove the floated seeds. After removal, the rest of the seeds (2220 nos.) were kept in water overnight. Next day, these seeds were sown in the prepared root trainers. A single seed was sown (approx. one cm deep) in one root trainer with the help of finger. The seeds were sown on 21st March 2003. These were sown gently and watered by the sprinkler. The seeds sown in root trainers were regularly observed and maintained (fig.-3).

Direct sowing of the seeds of R. serpentina in the field has not been reported successful (Badhwar, et. al. 1955a) and hence seedlings were raised in the root trainers in the nursery and transplanted into the field. Root trainers are meant for training the roots so as to have a well-developed root system used for raising quality seedlings.

In the present experiment, block type root trainers of 150 cc volume were used. They were 100mm long having the top diameter of 50mm and bottom diameter of 20 mm. Before sowing of seeds, soil samples were collected from 0 to 30 cm depth and analyzed for its physical and chemical properties. The soil was analyzed (physical) by the method given by Piper (1966). The chemical analysis of soil was also conducted. For organic, matter and carbon, Walkey and Black method (1934) was used and to find out available N, P and K, Alkaline permanganate method (Subbiah and Asija, 1956), Olsen's method (Olsen, 1954) and Flame photometer method were used respectively.

Soil excavated from central nursery area, sand and well rotten FYM were sieved and thoroughly mixed in the ratio of 2:1:1. The mixture was filled in the root trainers and was placed over the root trainer stands for seed sowing. In one block, 25 seedlings were grown. These blocks were kept on 9-inches high iron stands. The stands having filled root trainers were kept under the trees for imparting partial shade. Metrological data was collected for the period.

RESULT AND DISCUSSION

Table-1: Showing Details of Cultural Operations with Time

Sl. No.	Operations (July 2002 to May 03)	Time
1.	Collection of seeds	July 2002 & Nov. 2002
2.	Cleaning of plot	Feb 03
3.	Preparation of potting media	March 03
4.	Sowing of seeds	21st March 03
5.	First germination of seeds	19th April 03
6.	Date of complete germination	28th may 03

Table-1 depicts the Cultural Operations with Time. Seeds were collected in the month of July and Nov. 2002 and seeds were sown on 21st March 2003.

WEIGHT OF SEEDS

Table-2: Showing Weight of Seeds

Variables	Fresh Weight (gm)	Dried Weight (gm)
3000 seeds	600	125
100 single seeds	19.554	3.882
100 double seeds	37.472	7.872

Table-2 presents the fresh and dried weights of seeds. The fresh and dried weights of 3000 seeds were found to be 600 gm and 125 gm respectively. The fresh weights of 100 single and double seeds were 19.554 gm and 37.472 gm respectively and after drying, 3.882 gm and 7.872 gm were recorded in the same order.

DESCRIPTION OF SOIL

Table-3: Physical Analysis of Soil

Sl. No.	Soil Component	Content (%)	Method of determination
1.	Sand	45	Piper (1966)
2.	Silt	25	
3.	Clay	30	

The result of soil description are presented in table-3.The soil of the area was found silty clayey loam with 45 % of sand, 25 % of silt and 30 % of clay.

Table-4: Chemical Analysis of the Soil

Sl. No.	Soil Component	Value		Method of determination
		%	Per Ha	
1.	Organic Carbon	1.04		Walkey and Black method (1934)
2.	Organic Matter	1.79		
3.	pH	7.0		
4.	Available N	0.023	515 kg	Alkaline permanganate method (Subbiah and Asija, 1956)
5.	Available P	0.004	89 kg	Olsen's method (Olsen, 1954)
6.	Available K	0.007	156 kg	Flame photometer method

Table –4 presents the chemical analysis of the soil. The pH of the soil was observed 7.0 by soil: water suspension. Organic carbon and organic matter in the soil were found to be 1.04 % and 1.79 % respectively. The percentage of N, P and K was obtained 0.023 %, 0.004 % and 0.007 % respectively or 515 kg, 89 kg and 156 kg per hectare in the same order. According to Gupta (2003), the quantity of P was high and N as well as K was medium in the soil.

CLIMATE

The Doon valley lies between latitude 30 to 33°32′ N and longitude 77° 43′ to 73° 24′ E. It is an open valley enclosed by Shiwalik hills in the South, upper Himalayas in the North, Yamuna River on the West and Ganga on the East, (Srivastava and Kumar, 2003). The valley is protected from the extremes of climate. The meteorological data viz. maximum and minimum temperature, relative humidity in the morning and in the evening, rain fall, bright sunshine hours and wind velocity were recorded during the seed germination and are depicted in fig 4 to 6.

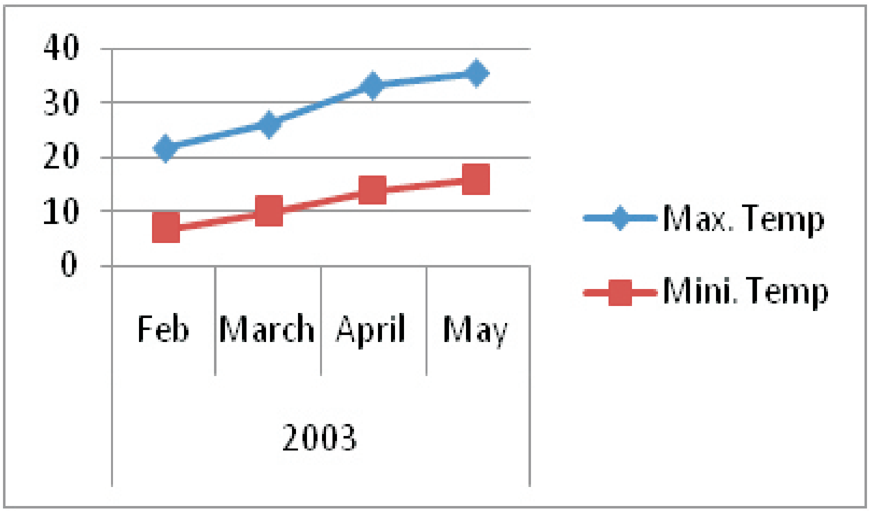

Fig.-4: Temperature during the Seed Germination

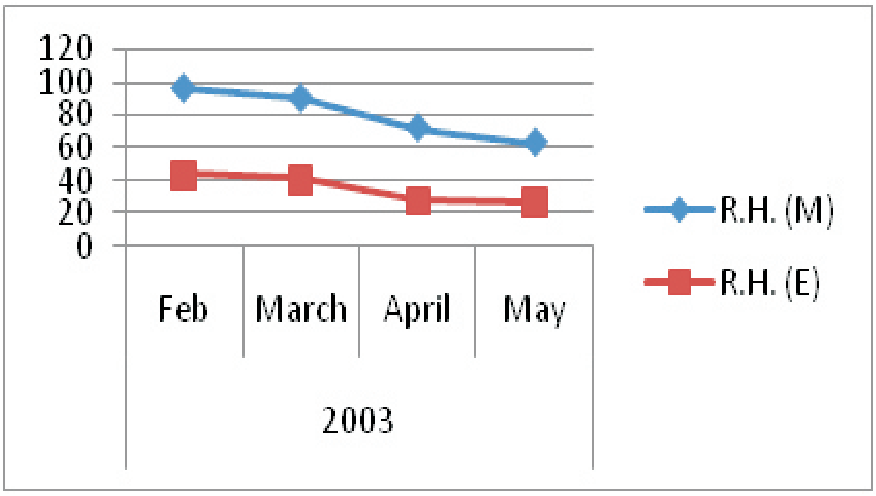

Fig.-5: Relative Humidity during the Seed Germination

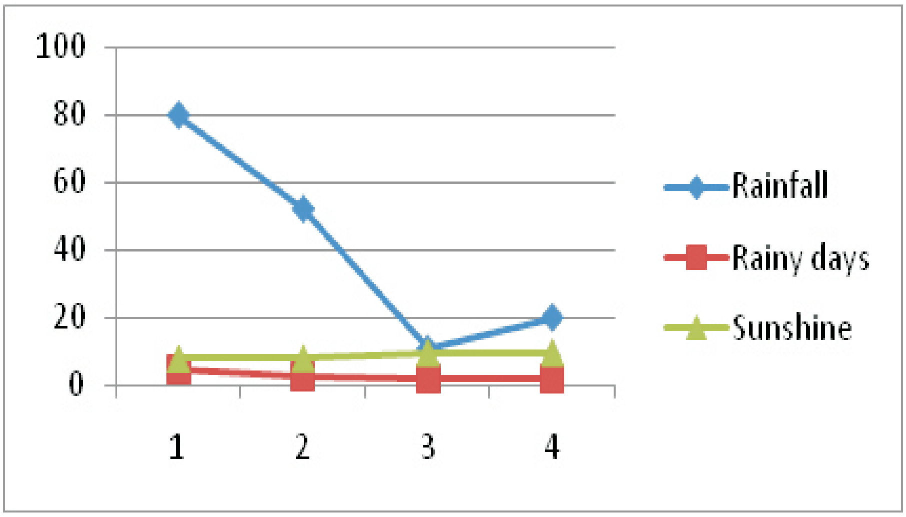

Fig.-6: Rainfall, Rainy Days and Sunshine hours during the Seed Germination

SEED GERMINATION

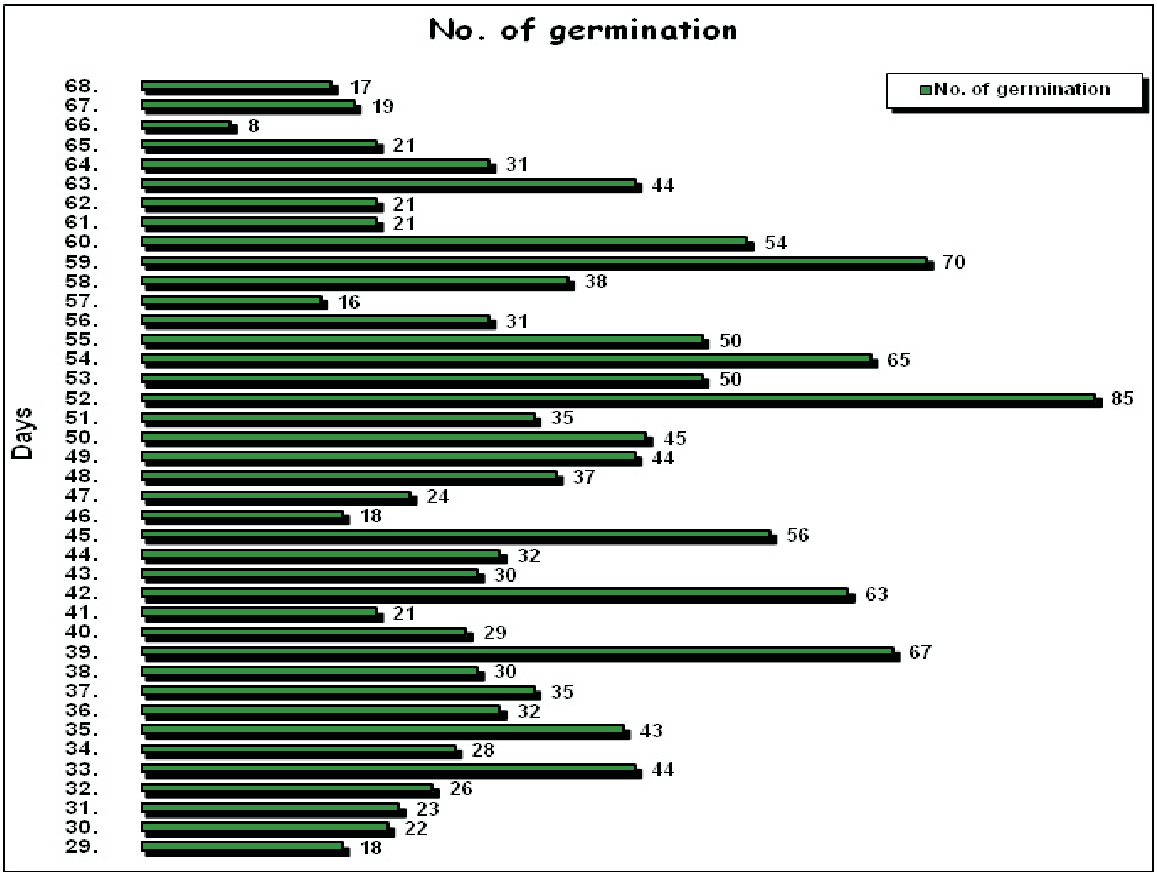

Fig.-7: Number of Seeds Germination

Fig.-7 presents the germination pattern of seeds. In the initial stage, the germination was gradual and the growth of seedlings was slow. The germination started after 28 days of sowing and ended in 40 days. The germination period extended from 29th day to 68th day after sowing. Out of 2220 seeds sown, total 1443 seeds were germinated. The number of germination of seeds increased and decreased gradually. Maximum number of germination occurred on 52nd (85 nos.) day after sowing followed by 59th day (70 nos.). The germination continued for 40 days. However, it was interesting to note that when the floated seeds were sown in another tray, the seeds were also germinated after 34 days and continued to germinate for 54 days. It was found that 10% of the floated seeds were also germinated.

The germination percentage was found to be 65% however, the germination percentage related to the total number of seeds collected (3000, including floated seeds) was noted 58 %.

A view to the metrological data and seed germination matrix reveals that maximum no of seeds germinated in mid may when maximum temperature and minimum temperature was 340C and 14.50 respectively. The rainfall and relative humidity in the morning and evening were 15mm, 68 and 27 respectively. The sunshine was 9.7. However, with the rise in temperature, the germination percentage gradually decreased.

It is reported that the plant is best propagated by seeds and seedlings should be raised in the nursery and transplanted in the field. Best results are obtained by sowing seeds in the month of March and April under the climate of Dehradun (Badhwar et. al., 1955a, 1955b; Sobti et. al., 1959). According to Sarin (1982), the ripen seeds collected from the beginning of June to end of October retain their viability for six months.

Majority of researchers have reported that germination of seeds R. serpentina is much lower (Nayar 1956, Dutta et al. 1962) even hot water treatment of seeds for any duration and temperature did not improve germination percentage (Jha and Sinha,1989). However, Padma et al. (1994) reported hot water soaking (800 C) for 5 minutes improved germination in Leucaena leucocephala. According to Hedayatullah (1959) seed germination of R. serpentina was quite erratic, ranged from 8-48% with an average of 19%. Nair (1955) observed 15-20% seed germination, and only 10-13% plant development from the germinated seeds. Pre sowing seed treatment with chemicals did not improve germination percentage and the germination inhibitors may be located inside the seeds (Paul et al., 2008). In contrary to these researches, 65% germination was found for heavy seeds and 10% for floating seeds. These results are in agreement with the work of Sobti et. al., 1959, they have informed 2 % germination of floated seeds. This may be due to the internal quality of seeds which further gradually germinated after 34 days and responded due to the availability of external attributes.

High percentage of germination was found in sandy clay soil (45 and 30 respectively). Chandra (1955) observed that R. serpentina prefer to grow in clay. In the present research work, the high percentage of germination is probably due to the provenance of the seed, favourable environmental conditions and type of the soil. In the process of germination, the seeds embedded in soil require an optimum temperature, water and oxygen as well as the presence of favourable endogenous factors within the seed itself (Mengel and Kirkby, 1987). The germination is also related to available nitrogen in the soil. of Shiva (2002) reported that mixing of FYM/compost is found beneficial for better propagation of seeds. Sobti et. al. (1959) recommended that well rotted FYM in the nursery beds is beneficial for the proper growth of seedlings. They reported that in Jammu, R. serpentina thrives best in soils rich in nitrogen. Rauvolfia species need a proper and balanced dose of nitrogen, phosphorous, potassium including carbon sources and others for growth and development often reflect their survival strategy in the community.

High blood pressure is one of the commonest 'killers' of the present times. Increasing stresses and strains of modern civilization, the drug has done miracles and is therefore considered as a great boon, resulting in its ever-increasing demand. If the demands were not fully cope up, chances of its substitutes like synthetic substances will be discovered and the position of importance, which R. serpentina has attained will definitely suffer. Also there will be fair chances of occurring various unforeseen side effects of the discovered synthetic substitute of R. serpentine.It appears that seed germination of R. serpentina is very complex (Paul et al., 2008), therefore further research is necessary to understand the mechanism of germination and raise the germination percentage for the benefit of community at large.

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Fig.-1: Fresh Seeds

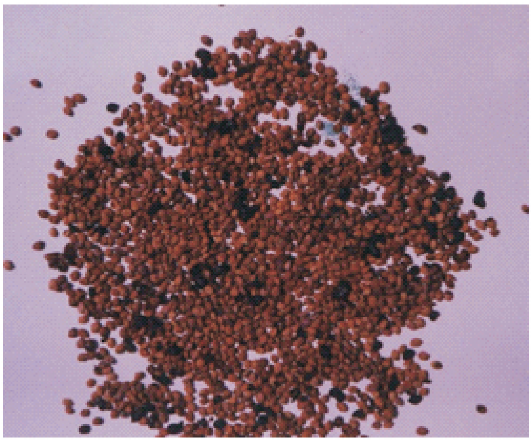

Fig.-2: Dried Seeds

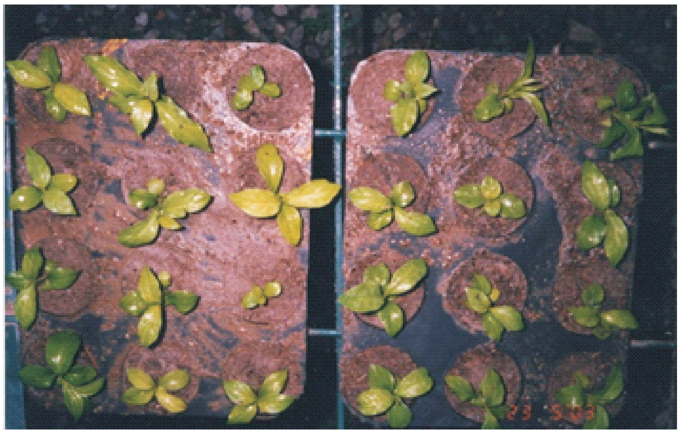

Fig.-3: Seed Germination in Root Trainers