

## Seed Traits Variation within the Plant in *Hyptis suaveolens* (L.) Poit

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**ABSTRACT** The theory of resource allocation has been widely used to examine the physiological basis for variation in reproductive output and the evolution of life history strategies in plant. The variation in numbers of fruit set, seed number, seed size, seed mass and seed germination was investigated at different branch position in *Hyptis suaveolens* (L.) Poit. Significant differences were observed in seed size and seed mass among different branches. Both large and small seeds developed within the same plant. The mass of large seeds were more or less two-fold greater than small seeds. Larger seeds showed a higher germination potential than smaller seeds.

**Key words:** *Hyptis suaveolens*, resource mobilization, seed number, seed mass, seed germination

In different plant species, several factors such as position of inflorescence on the mother plant or the position of seeds in the inflorescence or in the fruit influence seed quality [1]. The temporal and spatial differentiation in maturation and germination potential of seeds produced on the mother plant has immense ecological implications. The position of seeds on the mother plant can affect size, morphology, and subsequently germination rate [2]. Seed traits through their pronounced and multiple fitness effects are a determinant in the ecology and evolution of plant life [3]. Seed traits are closely related to germination timing [4]. Seed size and mass is considered as the component of fecundity, in comparison with plant size and seed allocation [4].

Variation in seed mass within a species may affect the germination percentage and rate [5] and it is reported that large seeds generally have higher germination rate than small seeds [6]. Factors inducing changes in seed mass include environmental factors [7], position of seeds within the fruit or on the plant [8, 9], the number of seeds per fruit [8, 10], and seed maturation

process [11]. The environmental factor such as restrictions in resource availability as the growing season advances or by changes in other ecological factors that affect plant growth also affects seed size [6, 7].

*Hyptis suaveolens*, an ethnobotanically important annual weed of Lamiaceae, is widely distributed in the tropics and sub tropics [12]. It normally grows in places where soils have been profoundly disturbed and may be considered as rudral species [13]. The plant parts are used by tribals as stimulant, carminative, suderfic, and galactogogue and contain a high amount of volatile oils [14]. The seeds of *H. suaveolens* show variation in size within the same population and even within the same plant [13]. The aim of this study was to investigate the seed size variation within the plants of *Hyptis suaveolens* L. Poit in natural populations and its effect on germination behavior.

### MATERIAL AND METHODS

The plant is an erect annual or short-lived perennial herb up to 2.5 m tall, strongly aromatic

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with woody rootstock, stems hollow, round quadrangular and much branched. Observations on growth, phenology, and ontogenesis were made in a natural population of *Hyptis suaveolens* (L.) Poit. in and around the IIT campus Kharagpur. Mature seeds of *H. suaveolens* (more than 100 plants) were collected in a branch specific manner, sun dried and stored in small glass vials in desiccators. Two branches of each node per plants were numbered I-VIII acropetally. The apex portion of the plant without any branching was numbered IX. The plant is characterized by asynchrony in flowering and flowering initiates in the lower branches and terminates at the apex of the main stem. The variation in branch length, number of reproductive nodes (inflorescence bearing) per branch, number of fruits per branch was noted at the end of the growing season. To study the variation of the seed size and shape of different positions of the healthy seeds from identical position of the plant were composited. Then few seeds from each position were randomly selected and the difference in seed size (length and breadth measured with the help of vernier caliper, 20 seed/replicates) and 100 seed weight (HSW) was noted. The seed size to mass and number of large seeds to small seeds per branch was calculated.

Seeds were grouped into two size classes i.e. large seed (length  $3.7 \pm 0.23$ , breadth  $2.1 \pm 0.14$ ) and small seed (length  $2.6 \pm 0.09$ , breadth  $1.7 \pm 0.06$ ) mm. Germination test was carried out in 100 x 4 seeds in Petri dishes on a double layer of Whatman No. 1 filter paper moistened with 5ml-distilled water. The seeds were kept to germinate at 30°C, 16h photoperiod and 85-90 per cent relative humidity inside the growth chamber. Germination percentage (G), mean germination time (MGT) and germination rate (GR) was calculated using the method of Mugnisjah and Nakamura [15].

$MGT = \Sigma(nt)/\Sigma(n)$ , where n = number of seeds emerged on a day, t = time or days from soaking.

$GR = 100/\Sigma Ni \times \Sigma(Ni \times Ti)$ , where  $Ti$  is the day after germination beginning and  $Ni$  is the number of seeds germinating on day  $Ti$ .

Data on germination were analyzed statistically, analysis of variance (ANOVA) F-test was done and the critical difference were computed using Fishers LSD procedure at  $p = 0.05$ .

## RESULTS AND DISCUSSION

*H. suaveolens* plants flowered in September-October at Kharagpur. Inflorescence was composed of axillary lax secund cymes with a few to many flowers. Flowering was asynchronous with the lower branches flowering first. The lower branches were longer than the upper branches (Table 1) produced a higher number of flowers. There was a significant difference among the branches in respect of fruit number. The fruits were nutlets enclosed in a persistent calyx, the number varying between two to four though the ovary was always four lobed. Large and small seeds/fruits were frequently found side by side. The numbers of both small and large seeds were found to decrease towards the terminal branch. Seeds from the branch III and IV showed high seed mass of large seeds and small seeds (Fig. 1) and also showed higher germination percentage than other branches (Table 2).

The ontogenesis of a plant consists of separate stages occurring in succession and the transition of plants from vegetative growth to the generative development i.e. the transition phase to flowering is especially interesting. Intraspecific variation in floral components and reproductive success is often located at the intra-individual level [16]. The arrangement of flowers within inflorescences explained this variation. The variation in number of ovules, fruit set, number of seeds per fruit, seed set, seed weight and seed germination were varied within the inflorescence. Seeds from I and II branch groups showed lowest germination percentages than seeds from III and IV branch, seeds produced in the middle of the flowering season have the advantages in terms of resource allocation of a optimum vegetative growth of the plant whereas seeds produced late would have declining resources. This has important consequences on harvesting of better seed lots when going for commercial production in selected crops. Earlier reports with safflower

Table 1. Branch length, nodes and fruit number along with seed type variation in *H. suaveolens*

Branch	Length of branch (cm)	No. of nodes/branch	No. of flowers/branch	No. of large seeds/branch	No. of small seeds/branch
I	78.00±3.12	14.75±0.98	96.75±4.14	170.00±4.49	49.25±0.85
II	50.00±3.02	12.00±0.22	84.25±3.92	152.50±2.75	41.25±1.08
III	43.00±1.47	11.25±0.21	74.50±2.24	120.00±2.34	34.25±0.64
IV	37.25±2.05	10.75±0.85	71.75±2.89	111.25±2.54	33.50±0.85
V	33.25±1.54	10.50±0.64	61.50±2.91	82.75±1.65	23.00±0.95
VI	24.25±1.10	8.75±0.98	46.50±3.01	74.75±2.05	20.00±0.45
VII	17.00±0.91	8.00±0.44	36.75±1.97	53.50±1.70	16.25±0.69
VIII	14.25±0.81	7.25±0.88	35.50±1.43	42.25±1.84	13.25±0.65
IX	24.00±1.47	10.75±0.75	89.25±3.84	139.25±2.25	42.25±1.25
L.S.D at 5% level	5.26	1.77	7.10	7.06	2.98

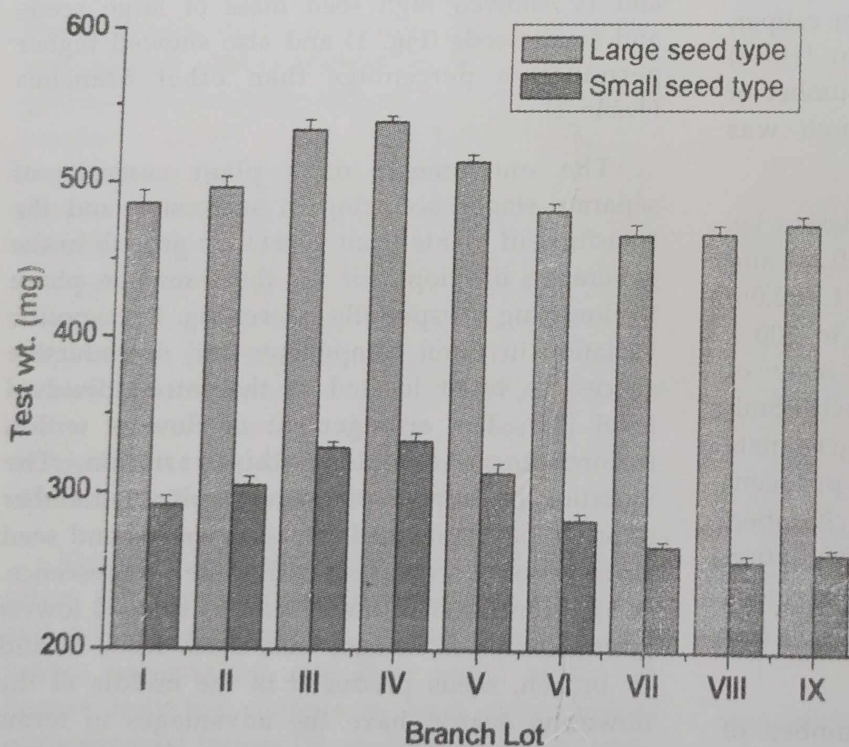


Fig. 1. Seed mass allocation in different branch lots

also indicate that seeds produced at the middle of the growing season have more vigor than those produced early or late [17].

The size of plant reproductive structures, because of architectural effects and resource constraints are important to explain the germination percentage variation within the inflorescence [18]. Within the inflorescence the seed weight fraction of reproductive biomass commonly decreases when resources are limiting. The present study showed that there was considerable variation in seed size within individual branch and large seed/small seed ratio decreased towards the terminal inflorescence. Seed size variation within seeds of the same flower might not be due to space constraints for developing ovule, a phenomenon common to some legumes [10], but could be due to competition between individual seeds for limited resources or a conserved genetic trait. Our experiments indicated that small seeds of *H. suaveolens* have a lower germination percentage than

Table 2. Germination pattern among different branch seeds within the individual plant *H. suaveolens*

Branch lot	Germination (%)		Germination rate		Mean germination time	
	Large seed	Small seed	Large seed	Small seed	Large seed	Small seed
I	81.33±2.74	56.00±1.15	0.33	0.67	4.62	5.33
II	84.00±2.04	59.33±1.33	0.28	0.54	4.33	5.50
III	88.33±1.51	62.66±0.86	0.33	0.57	4.75	4.83
IV	87.33±1.54	61.33±1.33	0.29	0.57	5.33	4.83
V	71.66±2.69	50.66±1.29	0.75	0.80	4.16	5.00
VI	59.33±1.93	45.33±0.78	0.83	1.25	4.80	5.00
VII	46.00±2.64	34.33±1.64	1.47	2.38	4.25	4.67
VIII	37.33±2.38	22.66±1.21	2.78	4.16	4.00	6.00
IX	39.66±2.27	26.33±0.88	2.38	2.22	4.67	5.00
L.S.D at 5% level	4.85	3.97				

larger seeds, suggesting a positive effect of seed mass on germination, which is supported by earlier reports on different plant species [13]. The larger a seed is the greater will be the metabolic reserve available to make up for lack of resources in the environment. That the large seeds germinate earlier than small seed is considered to provide the plant with an advantage of a longer effective season for growth and reproduction [19], and have a adaptive significance in establishing and maintaining the populations, because seedlings from large seeds are able to survive hazards [20].

The present study indicates a spatial and temporal difference in seed size-mass of *H. suaveolens* and a variation in germinability. Seeds with highest vigour with respect to germination percentage were obtained from the middle branches of the plant, which are more likely to form the major seed bank. These patterns explain the most commonly proposed hypothesis of architectural effects or resource competition. The present results thus suggest the need for further studies focusing directly to determine seedling behavior and characteristics

on selection for within-plant diversification to unravel the ecophysiological aspects of this variation.

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