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# Seed and Pod Trait Variations in *Bauhinia vahlii* Wight & Arn. in Lower Himalayan Regions of Himachal Pradesh

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***Abstract*:** The present study was carried out at Dr. Yashwant Singh Parmar University of Horticulture and Forestry Nauni, Solan during 2019-20. Five phenotypically superior genotypes of *Bauhinia vahlii* in four districts comprising of ten seed sources i.e. Nurpur , Dunera ( district Kangra,), Rangas , Balduk ,Tauni devi (district Hamirpur), Kathar (district Sirmour), Kuthar ,Dharbanar, Ramshehar and Bhojnagar (district Solan) were selected with an aim to evaluate the seed sources on the basis morphological and floral characteristics, and seed traits. The maximum average leaf length (23.8 cm) was in Dunera and maximum average leaf breadth (19.9 cm) and average pod length (23.3 cm) was from Nurpur area collections. Bhojnagar seed source proved better for seed weight (136.9 g) and seed germination (91.11 per cent). High heritability (1.00) with high genetic advance (14.37) was recorded for germination and highest genetic gain was also for germination (28.10 per cent). The seed weight showed high and positive correlation with germination per cent (0.847).

***Keywords*:** *Bauhinia vahlii*, Floral, Morphological, Performance, Seed source

*Bauhinia vahlii* Wight & Arn. is a woody climber of Caesalpiniaceae family. The species takes the support of nearby trees to grow high and may rise upto 15-30 metres depending upon the size of the supporting trees in the forest. It is well distributed in the sub-Himalayan region ranging upto 1500 metres above mean sea level and also found in Assam, Central India, Bihar, Eastern and Western Ghats. In Himachal Pradesh, it is well distributed in Solan, Sirmour, Hamirpur and Kangra districts. The white coloured flowers of this species which are arranged as corymbose terminal racemes; begin to appear during April and may continue upto June thereby the entomophilous pollination takes place with the anthesis of floral buds (Kedarnath 1982). It can grow in variety of soils ranging from alkaline rocky soil and acidic but in well drained condition (Chauhan and Saklani 2013). This species is well established as medicinal woody climber and its various parts have medicinal uses such as leaves are used as demulcent, edible seed as tonic, bark for extracting tannins and leaves are even used as fodder and commercially used as donnas and pattals (Agarwal 2003).

## MATERIAL AND METHODS

**Seed sources:** Survey was conducted from March 2019 to May 2019 in Himachal Pradesh for selection of seed sources and superior genotypes of *Bauhinia vahlii*. Total of 10 seed sources [Nurpur , Dunera (district Kangra,), Rangas, Balduk,Tauni devi (district Hamirpur), Kathar (district Sirmour), Kuthar, Dharbanar, Ramshehar and Bhojnagar (district Solan)] were identified and five best superior genotypes from each seed source were selected for fruit (pod) collection. From each genotype, seeds were collected from different positions and different directions of climber to avoid biasness of cross pollination. To ensure maximum genetic variation, source locations were at least 20 km apart from each other whereas selected climbers within location were at least 200 m apart from each other.

**Experimental site:** The present study was carried out at Dr. Yashwant Singh Parmar University of Horticulture and Forestry Nauni, Solan, Himachal Pradesh, India which is situated at 31.3674°N, 77.3057°E at an elevation of 1290 m above mean sea level, with an average annual rainfall of 1500 mm.

**Assessment of seed characters:** Seeds from selected genotypes were collected in May, 2019 and were used to study variation in seed parameters *viz*., pod length, pod width, seed weight and seed colour. A total of 30 pods per genotype were used under study. Hundred seed weight and seed colour was recorded. Randomized block design was used with 3 replications for each pod and seed parameter.

**Data analysis:** Data collected were subjected to for statistically significance using SPSS software (SPSS 2006). Genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) was calculated *Burton, 1952). Genetic advance and heritability (broad sense) were calculated (Lush 1940, Allard 1960, Panse and Sukhtame, 1978).

## RESULTS AND DISCUSSION

**Morphometric characteristics:** The average mean values

of leaf morphometric characters are depicted in the Table 2, Figure 1. The maximum leaf length and leaf breadth was recorded in Dunera (23.8cm) and Nurpur (19.9cm) seed source, respectively whereas the maximum leaf area and leaf petiole length was in Tauni Devi (394.4cm$^2$) and Bhojnagar (10.6cm) seed source, respectively (Table 1, Fig. 2). Anand and Dwivedi (2014) have also observed leaf morpho-metric variations in *Bauhinia variegata* leaf .

**Seed and pod characteristics:** The fresh seed weight showed significant variation among seed sources with maximum of 136.9g in Bhojnagar seed source which showed potential to germinate in other areas as well (Table 3, Fig. 2). The results of seed weight are consistent with the findings of Mathur et al 1982. Nurpur seed source had maximum pod length of 23.3cm whereas Dharbanar seed source showed the maximum pod breadth of 5.88cm (Table 3). Considerable morphological and physiological variations between provenanes are reported elsewhere in other species (Singhdoha et al 2017)

**Germination parameters:** The seeds of *B. vahlii* were

**Fig. 1.** Leaf length and leaf breadth of *Bauhinia vahlii*

**Fig. 2.** Seeds selected among different seed sources

**Table 1.** Geographical locations of *B. vahlii* seed sources selected in the present study

| Seed source | Code assigned | Locality covered | District | Altitude (m) (a.m.s.l) | Latitude | Longitude |
|---|---|---|---|---|---|---|
| Nurpur | $S_1$ | Jawali | Kangra | 478 | 32.1458° N | 76.0115°E |
| Dunera | $S_2$ | Katori Bangla | Kangra | 550 | 32.4451° N | 75.8912°E |
| Ramshahar | $S_3$ | Ramshahar | Solan | 815 | 31.0892° N | 76.7957°E |
| Rangas | $S_4$ | Jhaniari | Hamirpur | 890 | 31.7112° N | 76.4632°E |
| Balduk | $S_5$ | Jolsapad | Hamirpur | 900 | 31.690783° N | 76.517715°E |
| Kuthar | $S_6$ | Subathu | Solan | 1065 | 30.9731° N | 76.9672°E |
| Tauni Devi | $S_7$ | Bhokhar | Hamirpur | 1189 | 31.7144° N | 76.5972°E |
| Kathar | $S_8$ | Kathar | Sirmour | 1480 | 30.7667° N | 77.1442°E |
| Dharbanar | $S_9$ | Dharbanar | Solan | 1500 | 30.8294° N | 77.0748°E |
| Bhojnagar | $S_{10}$ | Bhojnagar | Solan | 1502 | 30.891° N | 77.17457°E |

**Table 2.** Variation in leaf morphometric characters of *B. vahlii* among different seed sources

| Seed source | Code | Leaf length (cm) | Leaf breadth (cm) | Leaf area (cm$^2$) | Petiole length (cm) |
|---|---|---|---|---|---|
| Nurpur | $S_1$ | 22.3 | 19.9 | 248.8 | 9.4 |
| Dunera | $S_2$ | 23.8 | 18.3 | 326.0 | 7.0 |
| Ramshahar | $S_3$ | 19.1 | 18.8 | 334.4 | 10.0 |
| Rangas | $S_4$ | 22.8 | 19.3 | 345.0 | 9.6 |
| Balduk | $S_5$ | 22.3 | 18.5 | 346.2 | 9.6 |
| Kuthar | $S_6$ | 22.6 | 19.9 | 328.9 | 9.3 |
| Tauni Devi | $S_7$ | 19.5 | 18.6 | 394.4 | 9.2 |
| Kathar | $S_8$ | 23.4 | 19.7 | 366.8 | 8.5 |
| Dharbanar | $S_9$ | 22.8 | 18.5 | 369.9 | 8.5 |
| Bhojnagar | $S_{10}$ | 23.1 | 18.4 | 380.7 | 10.6 |
| Mean | | 22.1 | 18.9 | 344.1 | 9.16 |
| CD (p=0.05) | | 2.0 | 1.5 | NS | 1.5 |

cleaned, graded and sown in polybags under glass house conditions. The maximum germination percentage was recorded in $S_{10}$ (Bhojnagar) seed source with the mean value of 91.11. While, germination energy (9.67) and germination value (23.91) were recorded maximum in Kuthar seed source (Table 4). The similar findings were recorded by Negi et al (2022) in pomegranate.

**Genetic estimates:** Genetic estimation is an important tool for evaluating data obtained from mother trees of different genotypes and half sib progenies after statistical analysis. Heritability, genetic gain and genetic advance are the major genetic parameters in tree improvement work. The highest Phenotypic Coefficient of Variation (PCV %) was recorded for germination energy (40.29) followed by germination value (35.19) whereas the lowest PCV was recorded for seed weight (9.03%) (Table 5). The highest Genotypic Coefficient of Variation (GCV %) was recorded for germination value (35.18), whereas the lowest GCV was recorded for seed weight (3.98%) followed by germination energy (5.62). These results are in general accordance with the findings of Showkat and Tyagi (2010) and Reni and Rao (2013). The results are also in agreement with the findings of Fakuta *et al*. (2015) where they found PCV was higher in proportion than GCV with respect to all the traits studied in *Acacia senegal*.

The results (Table 5) depicted high heritability (1.00) and genetic advance (14.37) for germination value whereas the highest genetic gain was recorded for germination % (28.10%). In forest trees similar findings were reported by Singh (2002) in full sib progenies of selected clones of Poplar (*Populus deltoides* Bartr.).

**Correlation coefficient:** Correlation is an important tool to

**Table 3.** Variation in seed and pod characteristics of *B. vahlii* among different seed sources

| Seed source | Code | 100 Seed weight (g) | Pod length (cm) | Pod breadth (cm) |
|---|---|---|---|---|
| Nurpur | $S_1$ | 113.4 | 23.3 | 5.62 |
| Dunera | $S_2$ | 113.6 | 23.2 | 4.82 |
| Ramshahar | $S_3$ | 121.7 | 19.3 | 4.76 |
| Rangas | $S_4$ | 121.8 | 25.1 | 5.29 |
| Balduk | $S_5$ | 130.6 | 21.2 | 4.86 |
| Kuthar | $S_6$ | 121.0 | 22.0 | 4.97 |
| Tauni Devi | $S_7$ | 124.8 | 17.6 | 4.83 |
| Kathar | $S_8$ | 126.9 | 20.5 | 5.47 |
| Dharbanar | $S_9$ | 132.4 | 21.2 | 5.88 |
| Bhojnagar | $S_{10}$ | 136.9 | 22.7 | 5.19 |
| Mean | | 124.3 | 21.62 | 5.17 |
| CD (p=0.05) | | 17.3 | NS | NS |

**Table 4.** Variation in seed germination parameters of *B. vahlii* among different seed sources

| Seed source | Code | Germination percentage (%) | Germination value | Germination energy |
|---|---|---|---|---|
| Nurpur | $S_1$ | 48.89 | 13.14 | 5.57 |
| Dunera | $S_2$ | 53.33 | 15.53 | 8.29 |
| Ramshahar | $S_3$ | 57.78 | 13.27 | 5.69 |
| Rangas | $S_4$ | 75.56 | 12.34 | 5.33 |
| Balduk | $S_5$ | 64.44 | 19.52 | 5.88 |
| Kuthar | $S_6$ | 66.67 | 23.91 | 9.67 |
| Tauni Devi | $S_7$ | 62.22 | 15.17 | 7.41 |
| Kathar | $S_8$ | 68.89 | 18.49 | 6.17 |
| Dharbanar | $S_9$ | 80.00 | 8.74 | 4.68 |
| Bhojnagar | $S_{10}$ | 91.11 | 5.31 | 7.88 |
| Mean | | 66.89 | 14.54 | 6.65 |
| CD (p=0.05) | | 2.34 | 2.12 | 4.56 |

**Table 5.** Genetic estimates of *B. vahlii* leaf, pod, seed morpho-metric, and seed germination attributes

| Character/parameter | Mean | Range | GCV | PCV | Heritability | Genetic advance | Genetic gain |
|---|---|---|---|---|---|---|---|
| Leaf length | 22.1 | 19.1-23.8 | 6.41 | 8.35 | 0.59 | 2.25 | 10.15 |
| Leaf breadth | 18.9 | 18.3-19.9 | 2.03 | 5.16 | 0.15 | 0.31 | 1.65 |
| Leaf area | 344.1 | 248.8-394.4 | 9.26 | 15.64 | 0.35 | 38.87 | 11.29 |
| Petiole length | 9.16 | 7.0-10.6 | 9.22 | 13.50 | 0.46 | 1.18 | 12.94 |
| 100 Seed weight | 124.3 | 113.4-136.9 | 3.98 | 9.03 | 0.19 | 4.49 | 3.61 |
| Pod length | 21.62 | 17.6-23.3 | 5.17 | 15.67 | 0.10 | 0.76 | 3.52 |
| Pod breadth | 5.17 | 4.76-5.88 | 5.44 | 10.51 | 0.26 | 0.30 | 5.81 |
| Germination percentage | 66.89 | 48.89-91.11 | 17.33 | 22.01 | 0.62 | 2.82 | 28.10 |
| Germination value | 14.54 | 5.31-23.91 | 35.18 | 35.19 | 1.00 | 14.37 | 21.47 |
| Germination energy | 6.65 | 4.68-9.67 | 5.62 | 40.29 | 0.02 | 0.10 | 1.61 |

**Table 6.** Simple correlation coefficient for leaf, pod, seed morpho-metric, and seed germination attributes of *B. vahlii*

| Traits | SW | PL | PB | LL | LB | LA | PTL | GP | GV | GE |
|---|---|---|---|---|---|---|---|---|---|---|
| SW | 1.000 | | | | | | | | | |
| PL | -0.245 | 1.000 | | | | | | | | |
| PB | 0.184 | 0.316 | 1.000 | | | | | | | |
| LL | 0.052 | 0.725* | 0.441 | 1.000 | | | | | | |
| LB | -0.419 | 0.228 | 0.320 | 0.126 | 1.000 | | | | | |
| LA | 0.742* | -0.468 | -0.151 | -0.128 | -0.530 | 1.000 | | | | |
| PTL | 0.450 | -0.060 | -0.071 | -0.402 | 0.102 | 0.083 | 1.000 | | | |
| GP | 0.847** | 0.153 | 0.320 | 0.299 | -0.258 | 0.666* | 0.396 | 1.000 | | |
| GV | -0.377 | -0.179 | -0.401 | -0.006 | 0.468 | -0.191 | -0.275 | -0.498 | 1.000 | |
| GE | -0.148 | -0.016 | -0.538 | 0.139 | 0.042 | 0.096 | -0.120 | -0.027 | 0.400 | 1.000 |

** = Highly significant at 1% level
* = Significant at 5% level
Where, SW= 100 seed weight, PL= pod length, PB= pod breadth, LL= leaf length, LB= leaf breadth, LA= leaf area, PTL= leaf petiole length, GP= germination percentage, GV= germination value, GE= germination energy index

measure the level of association between various characters. It plays an important role in tree improvement programmes as it helps in understanding the association among different characters whether one character is associated with the other character or not. The results computed in the Table 6 revealed that the seed weight gave highly positive correlation with germination percentage (0.847) and leaf area (0.742). The pod length gave highly positive correlation with leaf length (0.725). Leaf area gave highly positive correlation with germination percentage (0.666) at 1% level. The similar findings were reported by Divakara et al (2010) in *Pongamia pinnata*.

## CONCLUSION

The present investigations were carried out for the evaluation of Toor (*Bauhinia vahlii*) seed sources. The leaf size is the most important character of economic importance of this species that are even used as fodder and commercially used as donas and pattals. The seed source namely Bhojnagar accounted for better seed traits among all the seed sources followed by Dharbanar seed source.

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