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RESEARCH ARTICLE

PODS AND SEEDS TRAITS IN *STEREOSPERMUM TETRAGONUM* DC

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ABSTRACT

Stereospermum tetragonum DC. is a medicinal plant belonging to family Bignoniaceae. *S. tetragonum* is an important medicinal plant; therefore, it's planting and conservation has been recommended to prevent its extinction. In the present study we estimated the pod length and width, the number of seeds per pod, and number of seeds per kilograms of seeds using a descriptive analysis and the Analysis of Variance. We specified and estimated a regression model to study the relationship between the number of seeds per pod (dependent variable) and the pod length (independent variable). The estimated average pod length, pod width, seed number per pod, weight of 100 seeds (gm)and number of seeds per kilograms of seeds are 32.5±2.2, 4.0±0.2, 27±3, 1.08±0.02 and 92403±1535, respectively. With a 1% increase in average pod length, the average seed number per pod is estimated to increase by 0.9%.The results of this study will be useful for a yield improvement program of the plant, planning a sowing program, and in calculating the seed prices.

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INTRODUCTION

Stereospermum tetragonum DC. is a medicinal plant belongs to family Bignoniaceae that grows throughout tropical parts of Indian subcontinent (Subramoniam *et al.*, 2013), particularly, in sandy soils of river beds in Northern India and some parts of Tamil Nadu (Subramoniam *et al.*, 2013), It is used in the folk medical practices to treat *Diabetes mellitus* (Subramoniam *et al.*, 2013). In ethno-medical practices, the plant is also used as diuretic, anti-ulcer, and anti-pyretic (Shukla, 2009), and its fruits cure migraine (Shukla, 2009) and bark is useful in the treatment of piles (Shukla, 2009). It is used in the preparation of *Chyavanprash*(a popular Ayurvedic tonic) (Shukla, 2009). It has antimicrobial, antiprotozoal and anti-inflammatory properties (Binutu *et al.,* 1996). Free radical scavenging and xanthine oxidase inhibitory constituents have been obtained from extracts of both stem and stem-bark of *Stereospermum personatum* (Kumar *et al.,* 2005) which is of high therapeutic value.

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MATERIAL AND METHODS

The mature pods were collected during the month of March, 2015 from FRLHT, Bengaluru campus and observation for pods and seed characters were recorded as follows-

Pod characters

The pods were dried in shade, a total of 45 healthy pods were collected to make three replications containing 15 pods per replication. Observations on pods characteristics that are length and width were recorded. Pods length were measured from the tip of the pod to the point of attachment of the pod to the stalk and expressed in cm. Pod width was measured with the help of vernier caliper and expressed in mm.

Seeds weight

Weighing of 100 seeds for 10 replicates, separately is been done and the average weight of 100 seeds were calculated.

Amount of seeds per kilogram is calculated using the formula

$$amount\ of\ seeds\ per\ kilogram = \frac{1{,}000{,}000}{\text{average weight of 1000 seeds}}$$

Accuracy of the calculation is determined using the formula

$$cofficient\ of\ variation = \frac{100 \times \text{largest difference between replicates}}{2.85 \times average\ of\ 100\ seeds}$$

Cofficient of variation must be less than 4.

Table 1. Descriptive analysis

Characteristics	Average (± 95% C.I.)	Standard deviation	Coefficient of variation	Range
Replication 1				
Pod length (cm)	34.5±2.8	5.6	0.2	23.0
Pod width (mm)	4.4±0.2	0.4	0.1	1.3
No. of seeds per pod	25±2	5.0	0.2	18
Replication 2				
Pod length (cm)	29.2±3.8	7.4	0.3	28.8
Pod width (mm)	4.4±0.2	0.4	0.1	1.1
No. of seeds per pod	21±5	9	0.4	31
Replication 3				
Pod length (cm)	33.8±4.3	8.5	0.3	29.8
Pod width (mm)	4.5±0.4	0.7	0.2	2.1
No. of seeds per pod	25±5	10.4	0.4	46
Overall				
Pod length (cm)	32.5±2.2	7.6	0.2	33.2
Pod width (mm)	4.4±0.2	0.5	0.1	2.1
No. of seeds per pod	23±3	9	0.4	46
Weight of 100 seeds (gm)	1.08±0.02	0.03	0.03	0.10
No. of seeds per kg	92403±1535	2477	0.03	96139

C.I. = Confidence interval

Table 2a. Skewness/Kurtosis tests for Normality

Variable	Obs	Pr(Skewness)	Pr(Kurtosis)	Joint	
				adj chi2(2)	Prob>chi2
Replication 1					
Pod length (cm)	15	0.07	0.09	5.71	0.06
Pod width (mm)	15	0.01	0.28	6.7	0.04
No. of seeds per pod	15	0.83	0.77	0.13	0.94
Replication 2					
Pod length (cm)	15	0.31	0.42	1.89	0.39
Pod width (mm)	15	0.07	0.52	4.05	0.13
No. of seeds per pod	15	0.72	0.72	0.26	0.88
Replication 3					
Pod length (cm)	15	0.93	0.86	0.04	0.98
Pod width (mm)	15	0.44	0.31	1.87	0.39
No. of seeds per pod	15	0.32	0.08	4.37	0.11
Overall					
Pod length (cm)	45	0.94	0.85	0.04	0.98
Pod width (mm)	45	0.65	0.63	0.45	0.80
No. of seeds per pod	45	0.4	0.05	4.69	0.10

Table 2b. Shapiro-Wilk W test for normal data

Variable	Obs	W	V	Z	Prob>Z
Replication 1					
Pod length (cm)	15	0.92	1.56	0.87	0.19
Pod width (mm)	15	0.76	4.73	3.07	0.00
No. of seeds per pod	15	0.98	0.35	-2.10	0.98
Replication 2					
Pod length (cm)	15	0.92	1.64	0.97	0.17
Pod width (mm)	15	0.75	4.91	3.15	0.00
No. of seeds per pod	15	0.97	0.67	-0.81	0.79
Replication 3					
Pod length (cm)	15	0.96	0.69	-0.72	0.76
Pod width (mm)	15	0.93	1.38	0.63	0.26
No. of seeds per pod	15	0.89	2.09	1.46	0.07
Overall					
Pod length (cm)	45	0.99	0.56	-1.22	0.89
Pod width (mm)	45	0.89	4.55	3.21	0.00
No. of seeds per pod	45	0.95	2.26	1.72	0.04
Weight of 100 seeds					

Table 2c. Shapiro-Francia W' test for normal data

Variable	Obs	W′	V′	Z	Prob>Z
Replication 1					
Pod length (cm)	15	0.91	1.99	1.21	0.11
Pod width (mm)	15	0.76	5.21	2.91	0.00
No. of seeds per pod	15	0.98	0.44	-1.45	0.93
Replication 2					
Pod length (cm)	15	0.92	1.64	0.87	0.19
Pod width (mm)	15	0.80	4.30	2.58	0.01
No. of seeds per pod	15	0.99	0.18	-2.99	1.00
Replication 3					
Pod length (cm)	15	0.97	0.60	-0.90	0.82
Pod width (mm)	15	0.93	1.41	0.61	0.27
No. of seeds per pod	15	0.88	2.60	1.69	0.05
Overall					
Pod length (cm)	45	0.99	0.47	-1.43	0.92
Pod width (mm)	45	0.90	4.84	2.96	0.00
No. of seeds per pod	45	0.94	2.92	2.01	0.02

Table 3. Kruskal-Wallis equality-of-populations rank test

Replication No.	Obs	Rank Sum	chi2 (df=2)	Prob>chi2
Pod width (mm)				
1	15	379.50	0.876	0.6453
2	15	313.00		
3	15	342.50		
No. of seeds per pod				
1	15	372.00	2.594	0.2734
2	15	278.00		
3	15	384.50		

Table 4. Bartlett's test for equal variances

Characteristics	Pod length (cm)	Pod length (cm)	Pod length (cm)
chi^2 statistics (df=2)	2.34	5.23	8.59
Probability>chi2	0.31	0.07	0.01

Table 5. Analysis of Variance test for pod length

Source	Sum of Squares (SS)	degree of freedom (df)	Mean Sum of Square = SS/df	F	Prob>F
Between replications	250	2	125	2.22	0.1208
Within replications	2363	42	56		
Total	2613	44	59		

Table 6. Relationship between no. of seed and pod length

Dependent var. [ln(No. of seed per pod]	Coefficient	Std. Err.	t	P>|t|	[95% Conf. Interval]	
ln(pod length incm)	0.8918	0.014	63.67	0	0.8635	0.92
R-squared = 0.9893; Root MSE = 0 .32514; Number of observations = 45; F(1, 44) = 4053.55; Prob> F = 0.0000						

Statistical analysis

We used a descriptive analysis to estimate parameters namely, mean, coefficient of variation, range and confidence interval. We expect that data in three replications for variable namely, pod length, pod width and number of seeds per pod belong to same population. To test this hypothesis, we followed following procedure:

- Tested the normality of data by employing three methods:1) the skewness and kurtosis test of normality, and 2) the Shapiro–Wilk W test for normality (Shapiro and Wilk, 1965), and the Shapiro-Francia W' test for normal data.

- In case of non-normal data, we employed the 'Kruskal-Wallis One-way Analysis of Variance' test to test that the data in all replications belong to same population.
- In case the data is normally distributed, we used the Bartlett's test (NIST/SEMATECH e-Handbook of Statistical Methods, 2015) to test the hypothesis of equality of variances across replications.
- If the null of hypothesis of equality of variances is accepted, we employed the Analysis of Variance to test whether the means from three replications are significantly different or not. We did not find the case where the hypothesis of equality of variances is rejected.

We hypothesized that seed number in a pod depends on the length of the pod. To test this hypothesis and estimate degree of influence of pod length on seed number, we used following regression analysis

Seed number per pod = F (pod length).

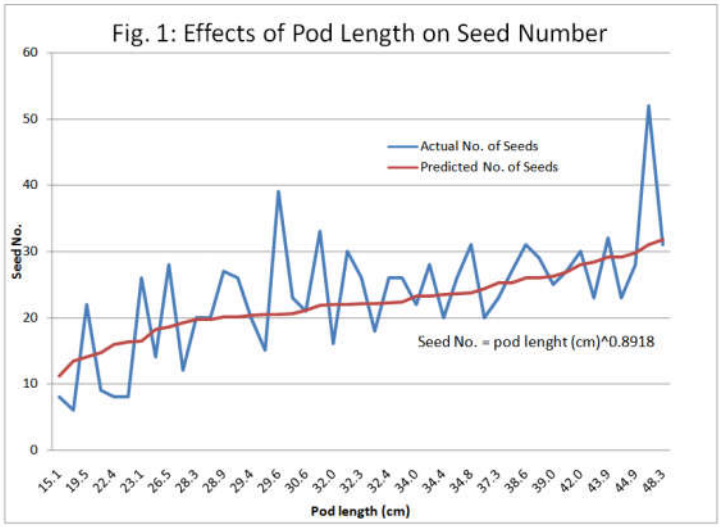
We specified and estimated several functional forms including linear, log-linear, and quadratic. Based on the R-square statistics, we selected the best fit model.

RESULTS AND DISCUSSION

Table 1 presents the results of descriptive analysis for each replication and overall situation. The results of the tests for normality of data (Tables 2a to 2c) show that pod width in Replications 1 and 2, and overall data, and seed number per pod in Replication 3 and overall data are not normally distributed; pod length is normally distributed.

The Kruskal-Wallis equality-of-populations rank test failed to reject the null hypothesis (Table 3) for pod width and no. of seeds per pod; this indicates that replication 1, 2 and 3 data belong to same populations. This suggests that we can pool data and estimate population parameters for variables namely, pod width and no. of seeds per pod.

As mentioned above, the pod length variable is normally distributed. Therefore, we tested for equality of variances across replications using the Bartlett's test. The estimated χ^2 statistics at 2 degree of freedom is 2.34 with level 0.31 level of significance. This means that the test could not reject the hypothesis of equality of variances across replications.



Number of seeds per kilogram

Sno.	Weight of 100 seeds(gms)	1000 seeds weight=100 seeds weight×10(gms).
1	1.08	10.8
2	1.04	10.4
3	1.14	11.4
4	1.09	10.9
5	1.10	11.0
6	1.08	10.8
7	1.07	10.7
8	1.06	10.6
9	1.12	11.2
10	1.05	10.5
Average	1.08	10.83

$$amount\ of\ seeds\ per\ kilogram = \frac{1{,}000{,}000}{\text{average weight of 1000 seeds}}$$

$$\frac{1{,}000{,}000}{10.83} = 92336.10$$

$$amount\ of\ seeds\ per\ kilogram = 92336.10$$

Cofficient of variation=3.24 (3.24<4).

Therefore, we used the Analysis of Variance test to test whether there is a significant difference among means of pod length across replications (Table 5). We did not find significant difference between means up to 0.12 level of significance (Table 5). As expected, these results suggest that the data on pod length in all replications belong to the same population; hence can be pooled to obtain single estimates of parameters.

The pooled estimates of parameters have been shown in Tale 1. The estimated average pod length, pod width, and seed number per pod, are 32.5±2.2, 4.0±0.2, and 27±3, respectively. The estimates of weight of 100 seeds (gm) and number of seeds per kilograms of seeds are 1.08±0.02 and 92403±1535, respectively. We specified several models including linear, log-linear, quadratic; however, log-linear model is found the best fit. This model explained about 99% variation in no. of seeds per pod (Table 6). Fig. 1 shows effects, the observed and predicted, of pod length on no. of seeds per pod; With a 1% increase in average pod length, the average seed number per pod is estimated to increase by 0.9%.

Conclusion

From the study it is concluded that the number of seeds per pods is positively related to the length of the pod (Healthier and larger pods has good number of seeds) that is directly related to the seed yield per plant. This will be useful yield improvement program of *Stereospermum tetragonum*. Number of seeds per kilogram is calculated which will be useful in planning sowing programmes and in calculating the seed prices.

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