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Variation of Seed Morphology of Different Sources and its Contribution to Seed Germination of *Santalum album* L.

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Abstract: ***It is most essential to have disease free and healthy seeds to have the desired productive crop populations. Though the genetic status is responsible for variations of different metrical traits of crop, the physiological basis of changes is also denoted for genetic screening. On the basis of these variations, the germplasm of the crops are categorized as genotypes, accessions, clones, varieties etc. It is also evident that there must have been some influences of genotypic environmental interaction. Considering all those facts, the seeds were collected from three different locations viz., Bangalore, Bankura and Burdwan. It was observed that there were some initial morphological differences between seeds which were collected from different sources. Lengths of seeds, breadth of seed, and 100 seed weight were measured. The rate of germination of each seed lot was taken into consideration. The observations were recorded in the bi-variant correlation tables. The correlation values of each location were calculated while the seed length was constant parameter in all the cases. The aims and objectives of this study is to find out the most suitable seed source for taking mass scale programme of raising quality seedling through artificial seed propagation technique.***

Keywords: variation, genotypic, germination, edaphic factors, correlation coefficient

1. Introduction

The fertility of seeds depends upon the quality of the seeds which is also a variable that depends on the age of the parent plant. At the time of seed collection it is worth noting the approximate age of the parent plant to justify the proper maturity as well as its juvenility. It is evident that the differences in seedling weight were partly due to differences in seed weight and partly differences in earliness of emergence (Sindhu Virendra, 2014). The environmental factors influence the germination pattern at the initial stage. Though the genetic variation for initial status is very small, such small initial differences between genotypes have strong influence on their final biomass. Hence, the germination pattern and seed size and weight in *Santalum album* L. are studied in this context. In fact presently there is no specific way of artificial means of propagation other than seed germination for the required improvement of sandal plant population. Ecologically sandal plant has adapted in various agro-climatic as well as soil conditions for in situ regeneration (Srinivasan et al., 1992; Rao et al., 2007; Batabyal and Tah, 2012).

2. Materials and Methods

Seeds were collected from three different places viz., Burdwan, Bankura and Bangalore. Mature fruits were collected from above mentioned three places and then seeds were soaked into normal tap water for an hour. After that, seeds were depulped thoroughly. Then depulped seeds were dried in shade for one week. After completion of drying, seed length, seed breadth (cm) and 100 seed weight (gm) of the seed lot from each place were measured. Seed lengths and breadths were measured with the help of Slide caliper. After taking the measurements one set of seeds of each place were treated with 0.08% GA_3 solution and another set of seeds were soaked into normal sterile water for about 24 hours. Next day, seeds were sown in the seed beds (different seed-beds were used for different places and treatments) made of saw dust and sieved river sand combined in 2:1 ratio. Seed beds were watered in every alternate day. Seed beds were under regular observation. Result of germination process was recorded carefully at regular interval. From these recorded data we calculate the correlation value following the bi-variate model of Panse and Sukhatme (1967). The graphical representations are also cited in this context.

3. Result and Discussion

Table 1: Correlation coefficient of seed length (cm) and seed breadth (cm) of *Santalum album* L. (Location: Bankura)

No. of observation	*Seed length (X)*	*Seed breadth (Y)*	X^2	Y^2	XY
1.	0.80	0.70	0.64	0.49	0.56
2.	0.65	0.55	0.42	0.30	0.35
3.	0.60	0.50	0.36	0.25	0.30
4.	0.60	0.55	0.36	0.30	0.33
5.	0.50	0.50	0.25	0.25	0.25
6.	0.60	0.45	0.36	0.20	0.27
7.	0.55	0.50	0.30	0.25	0.27
8.	0.50	0.40	0.25	0.16	0.20
9.	0.55	0.50	0.30	0.25	0.27
∑	**5.35**	**4.65**	**3.18**	**2.45**	**2.81**

r = 0.877

Table 2: Correlation coefficient of seed length (cm) and seed breadth (cm) of *Santalum album* L. (Location: Burdwan)

No. of observation	*Seed length (X)*	*Seed breadth (Y)*	X^2	Y^2	*XY*
1.	0.70	0.50	0.49	0.25	0.35
2.	0.80	0.55	0.64	0.30	0.44
3.	0.70	0.50	0.49	0.25	0.35
4.	0.75	0.50	0.56	0.25	0.37
5.	0.80	0.54	0.64	0.29	0.43
6.	0.70	0.51	0.49	0.26	0.35
7.	0.75	0.50	0.56	0.25	0.37
8.	0.80	0.55	0.64	0.30	0.44
9.	0.70	0.50	0.49	0.25	0.35
∑	6.7	4.15	5.00	2.40	3.46

r= 0.862

Table 3: Correlation coefficient of seed length (cm) and seed breadth (cm) of *Santalum album* L. (Location: Bangalore)

No. of observation	*Seed length (X)*	*Seed breadth (Y)*	X^2	Y^2	*XY*
1.	0.55	0.55	0.30	0.30	0.30
2.	0.70	0.50	0.49	0.25	0.35
3.	0.50	0.45	0.25	0.20	0.22
4.	0.70	0.50	0.49	0.25	0.35
5.	0.50	0.50	0.25	0.25	0.25
6.	0.55	0.45	0.30	0.20	0.24
7.	0.40	0.40	0.16	0.16	0.16
8.	0.50	0.45	0.25	0.20	0.22
9.	0.45	0.40	0.20	0.16	0.18
∑	4.85	4.2	2.69	1.98	2.94

r = 0.651

Table 4: Correlation coefficient of seed length (cm) and 100 seed weight (gm) of *Santalum album* L. (Location: Bankura)

No. of observation	*Seed length (X)*	*100 seed weight (Y)*	X^2	Y^2	*XY*
1.	0.80	19.02	0.64	361.76	15.21
2.	0.65	19.00	0.42	361.00	12.35
3.	0.60	18.70	0.36	349.69	11.22
4.	0.60	18.60	0.30	345.96	11.16
5.	0.50	18.55	0.25	344.10	9.27
6.	0.60	18.80	0.36	353.44	11.28
7.	0.55	18.50	0.30	342.25	10.17
8.	0.50	18.45	0.25	340.40	9.22
9.	0.55	18.65	0.30	347.82	10.25
∑	**5.35**	**168.27**	**3.18**	**3146.42**	**100.15**

r = 0.868

Table 5: Correlation coefficient of seed length (cm) and 100 seed weight (gm) of *Santalum album* L. (Location: Burdwan)

No. of observation	Seed length (X)	100 seed weight (Y)	X^2	Y^2	XY
1.	0.70	16.30	0.49	265.69	11.41
2.	0.80	15.50	0.64	240.25	12.4
3.	0.70	16.20	0.49	262.44	11.34
4.	0.75	15.70	0.56	246.49	11.77
5.	0.80	14.50	0.64	210.25	11.6
6.	0.70	16.01	0.49	256.32	11.20
7.	0.75	16.20	0.56	259.29	12.15
8.	0.80	16.10	0.64	262.76	12.88
9.	0.70	15.51	0.49	240.56	10.85
∑	6.7	142.02	5.00	2244.05	105.61

r= -0.508

Table 6: Correlation coefficient of seed length (cm) and 100 seed weight (gm) of *Santalum album* L. (Location: Bangalore)

No. of observation	*Seed length (X)*	*100 seed weight (Y)*	X^2	Y^2	*XY*
1.	0.55	13.20	0.30	174.24	7.26
2.	0.70	14.10	0.49	198.81	9.87
3.	0.50	12.70	0.25	161.29	6.35
4.	0.70	13.50	0.49	182.25	9.45
5.	0.50	12.30	0.25	151.29	6.15
6.	0.55	13.10	0.30	171.61	7.20
7.	0.40	12.10	0.16	146.41	4.84
8.	0.50	12.80	0.25	163.84	6.4
9.	0.45	12.05	0.20	145.20	5.42
∑	4.85	115.85	2.69	1494.94	62.94

r = 0.928

Table 7: Correlation coefficient of seed length (cm) and germination (%) of *Santalum album* L. (Location: Bankura)

No. of observation	*Seed length (X)*	*Germination (Y)*	X^2	Y^2	*XY*
1.	0.80	33	0.64	1089	26.4
2.	0.65	35	0.42	1225	22.75
3.	0.60	38	0.36	1444	22.8
4.	0.60	20	0.36	400	12.00
5.	0.50	60	0.25	3600	30
6.	0.60	40	0.36	1600	24
7.	0.55	50	0.30	2500	27.50
8.	0.50	30	0.25	900	15
9.	0.55	40	0.30	1600	22
∑	5.35	346	3.18	14358	202.45

r = -0.383

Table 8: Correlation coefficient of seed length (cm) and germination (%) of *Santalum album* L. (Location: Burdwan).

No. of observation	*Seed length (X)*	*Germination (Y)*	X^2	Y^2	*XY*
1.	0.70	52	0.49	2704	36.40
2.	0.80	36	0.64	1296	28.80
3.	0.70	46	0.49	2116	32.2
4.	0.75	50	0.56	2500	37.5
5.	0.80	40	0.64	1600	32.00
6.	0.70	51	0.49	2601	35.70
7.	0.75	30	0.56	900	22.50
8.	0.80	45	0.64	2025	36.00
9.	0.70	38	0.49	1444	26.60
∑	6.7	388	5.00	17186	287.7

r= -0.407

Table 9: Correlation coefficient of seed length (cm) and germination (%) of *Santalum album* L. (Location: Bangalore).

No. of observation	*Seed length (X)*	*Germination (Y)*	X^2	Y^2	*XY*
1.	0.55	18	0.30	324	9.9
2.	0.70	22	0.49	484	15.4
3.	0.50	19	0.25	361	9.5
4.	0.70	20	0.49	400	14.00
5.	0.50	21	0.25	441	10.00
6.	0.55	25	0.30	625	13.75
7.	0.40	21	0.16	441	10.5
8.	0.50	20	0.25	400	10.00
9.	0.45	18	0.20	324	8.1
∑	4.85	184	2.69	2734	101.15

r = 0.220

Table 10: Values of Correlation coefficient at a glance:

Characters	Location	r values
Seed length Vs. Seed breadth	Bankura	0.877
	Burdwan	0.862
	Bangalore	0.651
Seed length Vs.100 seed weight	Bankura	0.868
	Burdwan	-0.508
	Bangalore	0.928
Seed length Vs. Germination (%)	Bankura	-0.383
	Burdwan	-0.407
	Bangalore	0.220

Observations of different morphological parameters viz., seed length, seed breadth, 100 seed weight and germination percentage are recorded for the three different locations. Recorded data as observed, has been tabulated in bivariate correlation table (vide Table Nos. 1-9) following Panse and Sukhatme, 1967. As the parental plant population was in varied agro-climatic condition, every bivariate data was found variable. Table no. 10 shows the summary of the results where six cases of highly positive correlation and three cases of negative correlation values have been determined. In case of Burdwan, negative correlation coefficient value has been observed between the two pairs of variables namely, seed length and seed weight, seed length and germination %. This implies that the shorter is the length of the seed, the greater is the chance of germination in Burdwan location. Similar results can be concluded for Bankura district too. This variation of r-values may be due to the soil environments and edaphic factors of the said locations. It should be noted that the correlation coefficient only expresses association and by itself tells us nothing of the relationships between seeds collected from the different places. The maximum hundred seed weight was found in case of seed lot of Bankura and the minimum was found in case of Bangalore seed lot.

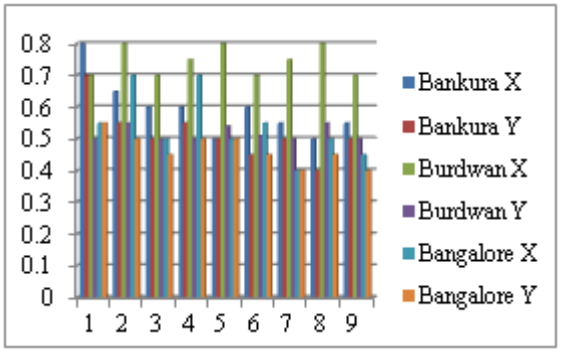

Figure 1: Graphical representation of comparative analysis of seed length (X) and seed breadth (Y) in the three locations.

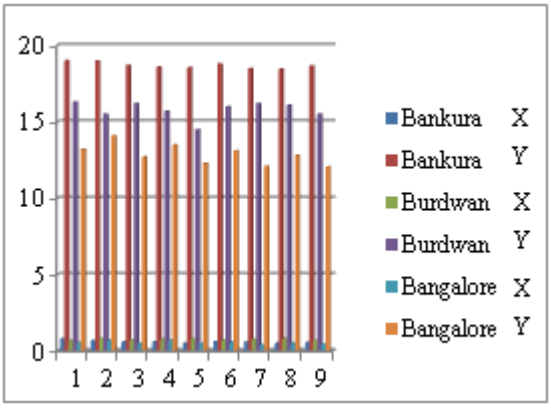

Figure 2: Graphical representation of comparative analysis of seed length (X) and 100 seed weight (Y) in the three locations

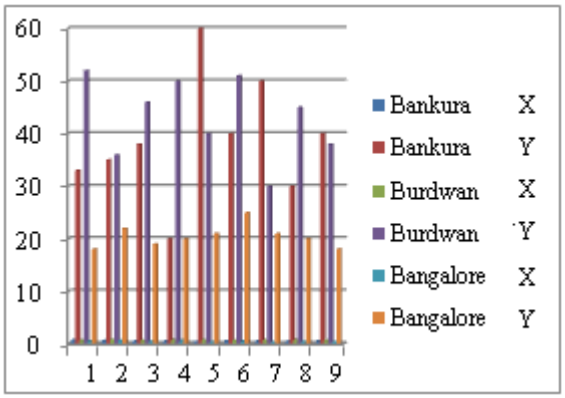

Figure 3: Graphical representation of comparative analysis of seed length (X) and seed germination (Y) in the three locations

Graphical representations (Fig I to III) have exhibited the variation of each metrical characters of each location distinctly. Each geographical bar has also indicated the potentiality of seed lot over the location. But the variation occurred due to other edaphic and environmental factors (Sothers, 1928; Khan, 1957; Shetty, 1981; Qureshi, 1955; Krishnamurthy et al. 1983; Jain et al. 1988, 2003;

Bhatnagar, 1965, Singh, 1911). It has also realized from the result that germination can be increased if we can take care of seed collection and its proper preservation till germination occurs.

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