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Study on the morphological variations in *solanum virginianum* and *solanum viarum* two allied species

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Abstract
Morphological variations in *Solanum viarurn* Dunal in DC. Prod. 13: 240d. 18: 2. and *Solanum virginianum* L. Sp. PL. 187. 1758; the two similar plant species of Solanaceae exhibiting marked taxonomical similarities in vegetative stage was studied. The data collected was also statically analysed. Both exhibited identical features as being diffuse herb or under shrub, very copiously armed all over with straight, yellow, very sharp prickles. However the co-efficient of variation in the leaves of the two plant species showed marked difference and were specific for each plant. New taxonornical methods have come into play for proper identification of plant species.

Keywords: *Solamum virginianum, Solanurn viarum,* Taxonomical variations, Co-efficient of variation

1. Introduction
The eight species of *Solarnum* L. found in Jharkhand show marked morphological similarities, specially the foliage of the majority of the plant species of this genus are alternate or sub opposite, entire or lobed or pinnatifid and many have prickles and spines distributed uniformly on both dorosal and ventral surface of the leaf lamina. Only two species namely *Solanum giganteum* and *Solanum torvum* have leaf lamina without prickles. All other species namely *Solanum trilobatum, Solanum virginianum, Solanum viarum, Solanum violaceum* and *Solanum melongena* have lamina with prickles. The two unarmed species are *Solanum nigrum* and *Solanum* erianthum. However all the above species except *S. virginianum* and *S. viarum* can be distinguished from each other by marked morphological characters. The two plant species in study, that is, *S. viaruin* and *S. virginianurn* are very much similar in appearance at vegetative stage. Minute statistical and morphological scrutiny of the foliage of the two allied species has been successfully attained and specific co-efficient of co-relation values have been described to the two plant species. Similar works were carried out by many workers (Dickson, 1969; Dichler, 1974; Crawford, 1976; Sachdeva and Malik, 1986 and Ambasta and Singh, 2009) [1].

2. Material and method
Collection of plant material
Plants materials of *Solanum viarurn* and *Solanum, virginianurn* were collected from Ranchi and where about *s.* (23° 210" N LR, 85° 20" EL) and Herbarium were prepared. The materials were properly identified and five Herbaria of each species was maintained at Department of Botany, Ramgarh College, Ramgarh.

Identification and measurement
Plant material were identified at Department of Botany, Ramgarh College, Ramgarh with the help of floras (Hains, HH. 1922 and Hooker, J. D. 1884) correct name for each taxon and their relevant synonyms have been presented with the help of latest floras and literature (Bennet, 1986).
Measurement in the variations of leaf of *Solanum viarurm* and *Solanum virginianum* was carried out in centimeter scale. The different specification considered were for leafs varying from the smallest to the largest. 1. Length of the leaf → from tip to the base of the petiole, 2. Breadth of leaf → measured at the broadest, 3. Length of terminal lobe, 4. Breadth of terminal lobe → at the broadest, 5. Length of petiole, 6. Length of largest spine, 7. Number of spines on petiole, 8. Number of spine or midrib, 9. Number of spine on leaf (Dorsal + Ventral) and 10. Number of lobes in the leaf (Table I and II).

Detail statistical analysis of the leave of the two plants was carried out for *Solanum viarum*
Refer Table I (*Solanum viarum*) we have a 10 x 11 matrix of data of 10 leaves with 11 characteristic for each (Goyal and Sharma, 2007). A correlation between the area of a leaf and number of spines on that leaf was established. We used Kearl Pearson's co-efficient of correlation formula, which suggests that if there are two sets of variables which have a relation between them then the co-efficient of correlation
Between them lies between ± 1, where co-efficient of correlation is denoted by.

$$\text{(row)}\ \ell = \frac{\frac{1}{N}\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\delta x \delta y}$$

where $\bar{x}$ = Mean of x_i' s

$\bar{y}$ = Mean of y_i' s and

δx = Standard deviation of x_i' s

δy = Standard deviation of y_i' s

and N = Total no. of observations

Here we take

x_i = Area of leaf (i = 1, 2, ... 10

y_i = Number of spines on leaf (i = 1, 2, ... 1

So

x_i = (Length of leaf x breadth of leaf) which have given in column 1 and 2 in Table I.

y_i = Sum of elements in column 7, 8, 9 and 10. That is Number of spines on petiole + No. of spines on midrib + No. of spines on leaf lobe (dorsal) + No. of spines on leaf lobe (Ventral).

Now we have the formula for standard deviation

$$\delta x = \sqrt{\frac{1}{N}\Sigma(x-\bar{x})^2} \qquad \delta y = \sqrt{\frac{1}{N}\Sigma(y-\bar{y})^2}$$

We have the following table with N = 10

x_i	y_i
55.00	50
59.85	50
81.60	52
88.90	54
97.68	54
113.76	56
126.36	57
163.76	61
166.47	61
181.00	61

$$\bar{x} = \text{Mean} = \frac{\Sigma x_i}{N} = 113.438$$

$$\bar{y} = \frac{\Sigma y_i}{N} = 55.6$$

$$\delta x^2 = \frac{1}{N}\ \Sigma\ (x_i - \bar{x})^2 = 1822.344$$

$$\delta x = 42.69$$

$$\delta y^2 = \frac{1}{N}\ \Sigma\ (y_i - \bar{y})^2 = 17.04$$

$$\delta y = 4.13$$

$$\therefore \ell = \frac{1}{N}\ \frac{\Sigma(x_i-\bar{x})(y_i-\bar{y})}{\delta x \delta y}$$

$$= \frac{1}{10}\ \left[\frac{1747.36}{42.69 \text{X} 4.13}\right] = (.99)$$

So we can safely infer that there is correlation between Area of leaf and number of spines on the leaf as the co-efficient lies between -1 and + 1.

Further all other specifications of a leaf was considered together.

Let

a = Average of areas of terminal lobes of 10 leaves.

b = Average of length of largest spines.

c = Average number of lobes in the leaf.

d = Average length of the petiole.

(Ad + be) = 36.43

Here

a = 7.92	a^2 = 62.72	ab = 6.1
b = 0.77	b^2 = 0.59	bc = 8.24
c= 10.70	c^2 = 114.5	ac = 84.7
d = 3.56	d^2 = 12.67	ad = 28.19
		bd = 2.74

Now we will try to correlate between ax+by and cx+dy

Let

u = ax + by and v = cx + dy.

We use the formula which has also been derived from the existing formula of correlation co-efficient as.

$$r_{uv} = \frac{ac\delta x^2 + bd\delta y^2 + (ad+bc)\delta x \delta y \ell}{\sqrt{\left\{a^2\delta x^2 + b^2\delta y^2 + 2ab\delta x\delta y\right\}\left\{c^2\delta x^2 + d^2\delta y^2 + 2cd\delta x\delta y\ell\right\}}}$$

Note If u and v are uncorrelated them r_{uv} should be zero.

Here δx^2 = 1822.344 δx = 42.69

δy^2 = 17.04 δy = 4.13 and

P = .99 using these values.

r_{uv} = 1.003

$\therefore$ So there is significant correlation between all the characteristic given in Table I

For *Solanum virginianum*

Pursuing the same methodology in table II we get the two sets of series as.

x_i	y_i
2.64	25
6.30	25
11.25	26
13.50	27
14.56	28
19.50	28
20.40	28
22.80	29
31.20	30
32.40	32

x = 17.452, y = 27.8

We get δx = 9.27, δy = 2.08

and ℓ = 0.95 which also lie between -1 and +1.

So same inference may be drawn

In method 2

a = 0.738 and r_{uv} = (0.992)

b = 1.04

c = 8.1

d = 1.07

Here the different value of *ruv* in relation between ax + by and cx + dy, indicate different leaf.

Thus with larger observations with different leaves, we can actually find out the actual value of correlation between ax + by and cx + dy with calculations involving more number of decimal places accurately.

Table 1: Variations in the Measurement of Leaf of *Solanum Viarum*

S. No.	Length of leaf (cms)	Breadth of leaf (cms)	Length of terminal (cms)	Breadth of terminal (cms)	Length of petiole (cms)	Length of longest spine	Number of spine or petiole	No. of spine on midrib	No. of spine on leaf lobe (Dorsal)	No. of spine leaf lobe (Ventral)	No. of lobes in the leaf
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1.	10	5.5	2.0	1.2	2.5	0.7	6	16	18	10	10
2.	10.5	5.7	2.2	1.3	2.7	0.7	6	16	18	10	10
3.	12	6.8	2.6	1.4	3.0	0.8	7	17	18	10	10
4.	12.7	7.0	2.7	1.6	3.2	0.8	7	17	19	11	11
5.	13.2	7.4	3.1	2.0	3.3	0.8	7	17	19	11	11
6.	14.4	7.9	3.6	2.2	3.6	0.8	7	18	20	11	11
7.	15.6	8.1	4.2	2.3	3.9	0.9	8	18	20	11	11
8.	17.8	9.2	4.8	2.4	4.4	0.9	8	19	23	11	11
9.	17.9	9.3	5.8	2.5	4.5	1.0	8	19	23	11	11
10.	18.1	10	6.0	2.7	4.5	1.2	8	19	23	11	11
Average					3.56	0.77					10.7

Table 2: Variations in the Measurement of Leaf of *Solanum virginianum*

S. No.	Length of leaf (cms)	Breadth of leaf (cms)	Length of terminal lobe (cms)	Breadth of terminal lobe (cms)	Length of petiole (cms)	Length of longest spine (cms)	Number of spine or petiole	No. of spine or midrib	No. of spine or leaf (Dorsal)	No. of spine or leaf (Ventral)	No. of lobes or leaf
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1.	2.4	1.1	0.4	0.2	0.4	0.8	3	7	8	7	7
2.	3.5	1.8	0.4	0.2	0.5	0.8	3	7	8	7	7
3.	4.5	2.5	0.8	0.5	0.7	1.0	3	8	8	7	8
4.	5.0	2.7	1.0	0.5	1.0	1.0	3	8	8	8	8
5.	5.2	2.8	1.0	0.6	1.0	1.0	4	7	9	8	8
6.	6.5	3.0	1.1	0.7	1.2	1.0	3	8	9	8	8
7.	6.8	3.0	1.1	0.7	1.3	1.1	4	8	9	7	8
8.	7.6	3.0	1.5	0.8	1.5	1.2	3	9	9	8	8
9.	7.8	4.0	1.6	0.8	1.5	1.2	4	9	9	8	9
10.	8.1	4.0	1.7	1.0	1.6	1.3	7	9	10	9	10
Average					1.07	1.04					8.1

3. Results and discussion

The emergence of experimental taxonomy has placed statistical analysis of morphological characters as a vital and useful key in the identification of plant species (Sachdeva & Malik, 1986; Bailey, 1959 [2] and Snedecor and Cochran, 1994). *Solanum* is a gregaricus genus represented by eight species in Jharkhand. Solanurn viarum (Fig.-1) and Solanurn virginianum (Fig.-2) are morphologically similar in appearance at juvenile stage. Both are armed plants with Lamina with prickles. Both the plant species are quiet common and have separate medicinal and religious values ascribed to them. *Solanum viarum* has Solasodine, a glycolalkaloid isolated from the berries which is an important raw material in the synthesis of steroidal drugs (Corticosteroides, sex hormones, oral contraceptives and anabolic agents). S. virginianum on the other hand has desperate significance, it being used in different socio-religious occasions. As such it is imperative that the plants are segregated at juvenile stage (vegetative stage) itself.

Fig 1

Fig 2

A simple key for the two species may suffice.
Erect diffuse

1. Diffuse sub shrub: Leaves Laerate. Fl — Blue; Bery-yellow with green blotches…….*S virginianum.*
2. Erect shrub: Leaves sinuate. Fl — White, Bery-yellow..... *S. viarum.*

The plants are difficult to be differentiated at vegetative stage owing to their similar foliage. However statistical analysis of the diverse foliage specification has yielded an interesting finding.

For *Solanum viarum* it was observed that there is a co-relation between Area of leaf and the number of spines on the leaf as the co-efficient lies between -1 and +1. Further the value of ^{r}uv i.e. correlation co-efficient when all other specifications are considered is 1.003 and again it is inferred that there is a significant co-relation between all the characters of the leaf.

For *Solanum virginianum* on the other hand the co-relation between Area of leaf and the number of spines on the leaf is 0.95. Whereas the correlation co-efficient between all the other specifications of the leaf is 0.992.

Here the different value of ^{r}uv in relation between ax + by and cx + dy, indicate different leaf. Thus with larger observation involving larger number of leaves a more specific co-relation between ax + by and cx + dy may be arrived.

4. References

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