VARIABILITY AND HERITABILITY OF SOME METRIC TRAITS OF *Solanum khasianum* CLARKE

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ABSTRACT

Genetic variability and heritability were estimated in ***Solanum khasianum*** Clarke. Phenotypic variability ranged between 0.03 for fruits/bunch and yield/plant, and 787.39 for number of fruits/plant. Genotypic variability was highest (497.07) for number of fruits/plant and lowest (0.01) for fruits/bunch and solasodine content. Genotypic coefficients of variability were high for number of branches/plant, number and yield of fruits/plant, and solasodine yield/plant indicating the potential for advancement by selection. Heritability estimates were high for days to flowering and fruiting, and number and yield of fruits/plant; medium for number of branches, flowers/bunch, fruits/bunch and solasodine yield/plant; and low for days to maturity, height and solasodine content. Genetic advance varied between 0.08 for solasodine content and 36.49 for number of fruits/plant. Genetic advance expressed as percent of mean was highest (36.02%) for solasodine yield/plant and lowest (0.15) for solasodine content. The characters with high heritability estimates did not show high genetic advance indicating non-additive gene effects and therefore low expected genetic gain by selection. In the case of number of branches, number and yield of fruits/plant, and solasodine yield/plant, high phenotypic coefficient of variability associated with high genotypic coefficient of variability and high genetic advance indicated the possibility of improvement with respect to these characters by mass selections.

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KEY WORDS: ***Solanum khasianum.*** Solasodine. Genotypic variance. Heritability. Genetic advance. Mass selection.

INTRODUCTION

Solanum khasianum Clarke has now become an economically important species because of the presence of glyco-alkaloid solasodine in its fruits. Solasodine, a nitrogen analogue of diosgenin, is acceptable as an alternate raw material by industries engaged in the synthesis of steroid hormones, cortisones and oral contraceptives (Coppen, 1979). Because of the dwindling supply of diosgenin and the increasing world industrial needs, attempts are now being made to cultivate *S. khasianum* in large-scale. Although preliminary work on cultural practices has been carried out, the work on genetic improvement is very limited (Chauhan et al., 1976; Janaki Ammal and Bhatt, 1971; Khanna and Murty, 1972) and basic information on various genetic parameters is still lacking. The present investigation was therefore initiated to estimate variability and heritability for some metric traits in *S. khasianum.*

MATERIALS AND METHODS

From the collection maintained at the Regional Research Laboratory (RRL), Jorhat, Assam, India, 30 promising materials of *S. khasianum* were chosen for this study and their selfed seeds were utilized.

The seeds were first sown in polyethylene sleeves filled with soil-compost mixture (1:1). Following emergence and when the seedlings were one month old, they were then transplanted to the field. The field layout was a randomized complete block design with three replications. The individual entry was represented in each block by a three-row plot with five plants in each row. The spacing between and within the row was 80 cm. N, P and K were applied at 120, 90 and 90 kg/ha, respectively. P and K, and half of N were applied basally. The rest of N was applied in two equally split doses at one month interval after the basal application. Irrigation and all other cultural operations were kept uniform.

Five plants were randomly selected in each plot and the days to flowering (opening of first flower), days to fruiting (formation of first fruit), days to maturity (ripening of first fruit), height at maturity, number of branches/plant, number of flowers and fruits/bunch (based on 10 bunches/ plant), number and yield of fruits/ plant, solasodine content (% dry wt. by analyzing a representative sample from each plot), and solasodine yield (g/plant, calculated on the basis of fruit yield and solasodine content) were recorded. The analysis for solasodine was carried out using the method of Choudhary and Rao (1964).

The averages of all data gathered were used for statistical analyses. Genotypic (σ_g^2) and phenotypic (σ_p^2) variances and heritability in the broad sense (h^2) were calculated following the formula cited by Osman and Khidir (1974):

$$h^2 = \frac{\sigma_g^2}{\sigma_p^2} \times 100$$

where σ_g^2 is genotypic variance and σ_p^2 is phenotypic variance.

Phenotypic (PCV) and genotypic (GCV) coefficients of variability were calculated using the formula suggested by Burton and de Vane (1953) as cited by Osman and Khidir, 1974:

$$PCV = \frac{\sqrt{\sigma_p^2}}{\overline{x}} \times 100$$

$$GCV = \frac{\sqrt{\sigma_g^2}}{\overline{x}} \times 100$$

where $\overline{x}$ is the mean and σ_g^2 and σ_g^2 are phenotypic and genotypic variances, respectively.

The genetic advance (GA) and GA as percent of mean were calculated following the formula used by Johnson et al. (1955) as cited by Osman and Khidir, 1974:

$$GA = \frac{\sigma_g^2}{\sigma_p} K$$

where σ_g^2 is genotypic variance, σ_p is phenotypic standard deviation and K is 2.06.

$$\text{GA as \% of mean} = \frac{K}{\overline{x}} \frac{\sigma_g^2}{\sigma_p}$$

RESULTS AND DISCUSSION

The means, range and standard error for different characters in *S. khasianum* are presented in Table 1. The analysis showed significant differences for days to flowering, days to fruiting, height, number of branches/plant, number of flowers/bunch, number and yield of fruits/plant, and solasodine yield/plant. The differences for the rest of the characters, however, were not statistically significant.

The estimates of σ_g^2, σ_p^2, h^2, GA, GA as percent of mean, GCV and PCV are given in Table 2. A wide range of

Table 1. Range, mean and standard error (S.E.) for different characters of *Solanum khasianum.*

Character	Range	Mean ± S. E.
Days to flowering	68.8-88.0	79.03 ± 1.40
Days to fruiting	82.0-96.6	87.80 ± 1.34
Days to maturity	154.0-159.0	156.10 ± 0.56
Height (cm)	93.0-160.6	123.80 ± 7.67
Number of branches/plant	38.0-130.0	65.98 ± 6.89
Flowers/bunch	3.0-5.0	3.82 ± 0.19
Fruits/bunch	2.0-3.0	2.30 ± 0.13
Number of fruits/plant	65.0-261.0	151.31 ± 17.04
Yield of fruits/plant (kg)	0.3-1.5	0.82 ± 0.11
Solasodine content (% dw)	1.1-3.5	1.98 ± 0.26
Solasodine yield/plant (g)	1.7-6.3	3.26 ± 3.16

Table 2. Estimates of genotypic and phenotypic variability, heritability, genetic advance, genetic advance as percent of mean, and genotypic and phenotypic coefficients of variability for some metric traits in *Solanum khasianum.*

Character	Genotypic Variability (σ^2_g)	Phenotypic Variability (σ^2_p)	Herita-bility (h^2)	Genetic Advance (GA)	Genetic Advance as % of Mean	Genotypic Coefficient of Variability (GCV)	Phenotypic Coefficient of Variability (PCV)
Days to flowering	6.51	8.46	76.95	4.62	5.85	3.23	3.66
Days to fruiting	4.89	6.68	73.20	3.90	4.44	2.52	2.94
Days to maturity	0.11	0.42	26.19	0.33	0.21	0.06	0.13
Height (cm)	19.24	78.11	24.63	4.49	3.62	3.54	7.13
Number of branches/plant	44.74	92.19	48.53	9.60	14.56	10.15	14.57
Flowers/bunch	0.03	0.07	42.86	0.27	7.04	4.76	6.63
Fruits/bunch	0.01	0.03	33.33	0.14	5.87	4.55	7.26
Number of fruits/plant	497.07	787.39	63.13	36.49	24.15	14.75	18.57
Yield of fruits/plant (kg)	0.02	0.03	66.67	0.19	23.68	15.46	20.86
Solasodine content (% dw)	0.01	0.08	12.50	0.08	0.15	5.18	13.96
Solasodine yield/plant (g)	13.96	23.96	58.26	5.88	36.02	22.85	29.96

both genotypic and phenotypic variability was observed for all the characters studied. σ^2_p varied between 0.03 for fruits/bunch and yield of fruits/plant and 787.39 for number of fruits/plant. The values of σ^2_g ranged from 0.01 for fruits/bunch and solasodine content to 497.07 for number of fruits/plant. It may also be noted that a high σ^2_g was associated with a high σ^2_{p}. The GCV takes the mean and the unit of measurement into consideration and presents in one statistic an index of potential advance latent within the population (Burton and de Vane, 1953). The GCV values in this study were high for number of branches, number and yield of fruits/plant and solasodine yield/plant, i.e. 10.15, 14.75, 15.46 and 22.85, respectively. High GCV values observed for the characters mentioned above thus indicate that the material had the latent potential for advancement by selection with respect to these characters.

Heritability estimates (h^2) were relatively high for days to flowering (76.95), days to fruiting (73.20), number of fruits/plant (63.13) and yield of fruits/plant (66.67); medium for number of branches (48.53), flowers/bunch (42.86), fruits/bunch (33.33) and solasodine yield/plant (58.26); and low for days to maturity (26.19), height (24.63) and solasodine content (12.50). The values of GA varied between 0.08 for solasodine content and 36.49 for number of fruits/plant. GA expressed as percent of mean was highest (36.02%) for solasodine yield/plant and lowest for solasodine content (0.15). GCV varied from 0.06 for days to maturity to 22.85 for solasodine yield/plant. PCV similarly was lowest for days to maturity (0.13) and highest (29.96) for solasodine yield/plant.

Heritability estimates are helpful in deciding whether selection would be an effective method of improvement. In reality, h^2 is a measure of selection system in separating genotypes (Burton and de Vane, 1953). At a fixed selection pressure, amount of advance varies with magnitude of h^2 (Osman and Khidir, 1974). Johnson et al. (1955), however, suggested that h^2 estimates along with GA are more useful than h^2 alone in selecting best genotypes. The h^2 estimates observed in this study were generally not too high, indicating a narrow genetic base. Days to flowering and days to fruiting with relatively high h^2 estimates did not show high GA as such or as percent of mean. On the other hand, fruits/bunch, number of branches/plant, yield of fruits/plant and solasodine yield/plant with only medium h^2 showed higher GA as such and expressed as percent of mean. A high h^2 coupled with a high GA indicates predominance of additive genetic variance (Panse, 1957), and this would consequently bring about high genetic gain (Osman and Khidir, 1974). The lack of this relationship, as observed in this study, may indicate non-additive gene effects, thus, a low genetic gain would be expected from selection. High PCV associated with high GCV and high GA, however, indicates the possibility of improvement by mass selection (Osman and Khidir, 1974). It would thus be possible to bring about improvement by mass selection for such characters as number of branches, fruits/bunch and yield of fruits/plant and solasodine yield/plant wherein high PCV values were associated with high GCV and high GA in this study.

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