

HERITABILITY ESTIMATES IN APPLE (*Malus X domestica* Borkh)

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The study of heritability and genetic advance is very useful in order to estimate scope for improvement by selection. Tancred et al. (1995) observed that the knowledge of heritability is useful while planning with a specific objective. In apple, the yield, growth habit, flowering, duration of flowering, beginning of maturity, fruit shape, size weight, colour and keeping quality are governed by polygens (Henning, 1947; Schmidt, 1982; Sedov, 1970; Sedov & Serova, 1984). In the present study the inheritance of growth, flowering, fruiting and yield characters in apple have been reported under agro-climatic conditions of Solan, Himachal Pradesh.

The coefficient of variability, heritability and genetic advance in 24 (Aziza, Cox's Orange Pippin, Skyline Supreme, Tropical Beauty, Parlin's Beauty, Red Baron, Nemared Delicious, Top Red, Hardeman, Idared, Red Royal, Emperor, Stoyanova Krasavista, Stark Summer Gold, Morspur, Stark Red Rome, Early McIntosh, McIntosh, Paragon, Mollie's Delicious, Sweet Semi Red, Scab Resistant, Alkane, Maayan and Spur Type Red Delicious) apple genotypes were worked out following standard procedures.

The experimental site was located at 1250 m a.m.s.l. situated at 31° N latitude and 77° E longitude with an average rainfall of 1200 mm. The soils were Ethrochrept high in organic matter, neutral in reaction and sandy clay loam in texture. Three uniform trees in each genotype were taken for recording the observations and analysed following Panse and Sukhatme (1961). The data on various traits were recorded as per the standard procedure.

The heritability estimates were high for days after full bloom, yield/plant, days between date of patel fall and date of commencement of June drop, days between date of commencement of June drop and date of harvesting, mean fruit weight, number of flowers/unit shoot length, number of fruits/unit shoot length, fruit yield/unit shoot length, total duration of flowering, leaf area, fruit set 40 days after full bloom (DAFB), final fruit before harvesting and mean fruit breadth. Mean tree spread, days to full bloom, tree volume, mean fruit length, fruit 20 DAFB and plant height showed moderate heritability. Stem girth had low heritability value (Table 1). Fairly high coefficient of heritability for fruit weight (Serova, 1989) and mean fruit breadth (Shin et al. 1986) were reported. Boicheva (1976) and Durel et al. (1988) found medium heritability for fruit size in apple. The results obtained in the present investigation are in agreement with those of earlier. The heritability magnitude indicates the reliability with which the genotype will be recognized by its phenotype expression. High heritability estimates indicate that the selection for these characters will be effective being less influenced by environmental factors.

Johnson et al. (1955) impressed that heritability values along with estimates of genetic advance were more useful than heritability alone in predicting the effect of selection. High heritability estimates associated with high genetic advance as percent mean (GA) were obtained in the characters viz. number of flowers/unit shoot length, final fruit before harvesting, yield/plant and fruit yield/unit shoot length, which indicated that selection for these characters would be effective because their high heritability and GA (expressed as percent mean). High heritability values followed by high GA indicated the presence of additive gene action (Table 2 and 3).

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Table 1. Variability parameters for growth characters in apple

Trait	Mean	Range	Genotype variance	Phenotype variance	GCV	PCV	ECV	Heritability % (broad sense)	GA	GA as % of mean
SG	47.0	31.0-72.3	67.2	171.5	17.4	27.8	21.7	39.2	10.6	22.5
PH	5.3	2.1-8.0	1.4	2.5	22.0	29.9	20.2	54.5	1.8	33.5
MTS	4.5	2.2-6.6	1.0	1.4	21.8	26.6	15.1	67.9	1.7	37.3
LA	180.8	95.4-264.9	1501.3	1929.7	21.4	24.3	11.5	77.8	70.4	38.9
TV	62.2	12.8-132.7	852.5	1421.7	47.0	60.6	38.4	60.0	46.6	74.9

SG- Stem girth, PH- Plant height, MTS- Mean tree spread, TV- Tree volume, GCV- Genotype Coefficient of variation, PCV- Phenotype Coefficient of variation, ECV- Environmental Coefficient of variation, GA- Genetic advance.

Table 2. Variability parameters for flowering characters in apple

Trait	Mean	Range	Genotype variance	Phenotype variance	GCV	PCV	ECV	Heritability % (broad sense)	GA	GA as % of mean
SG	47.0	31.0-72.3	67.2	171.5	17.4	27.8	21.7	39.2	10.6	22.5
PH	5.3	2.1-8.0	1.4	2.5	22.0	29.9	20.2	54.5	1.8	33.5
MTS	4.5	2.2-6.6	1.0	1.4	21.8	26.6	15.1	67.9	1.7	37.3
LA	180.8	95.4-264.9	1501.3	1929.7	21.4	24.3	11.5	77.8	70.4	38.9
TV	62.2	12.8-132.7	852.5	1421.7	47.0	60.6	38.4	60.0	46.6	74.9

SG- Stem girth, PH- Plant height, MTS- Mean tree spread, TV- Tree volume, GCV- Genotype Coefficient of variation, PCV- Phenotype Coefficient of variation, ECV- Environmental Coefficient of variation, GA- Genetic advance.

Table 3. Variability parameters for yield and fruiting characters in apple

Trait	Mean	Range	Genotype variance	Phenotype variance	GCV	PCV	ECV	Heritability % (broad sense)	GA	GA as % of mean
NF/ USL	6.2	3.2-9.7	3.1	3.6	28.2	30.5	11.6	85.5	3.3	53.8
FS 20 DAFB	17.1	6.5-28.8	86.0	152.2	35.0	46.5	39.7	56.5	14.4	54.2
FD 40 DAFB	17.1	6.5-28.8	39.2	52.0	36.6	42.1	20.9	75.4	11.2	65.4
FFBH	14.5	6.7-25.6	25.8	34.7	35.1	40.7	20.6	74.4	9.0	62.4
Yield/P	14.5	1.7-25.0	42.1	44.3	90.6	92.9	20.6	95.0	13.0	182.0
MFW	114.8	54.9-188.3	577.4	628.4	20.9	21.8	6.2	91.9	47.5	41.3
MFL	5.5	4.0-6.6	0.4	0.6	11.0	14.4	9.23	58.94	0.8	17.5
MFB	6.6	3.3-8.0	0.7	1.0	12.7	14.8	7.6	73.8	1.5	22.4
FY/ USL	846.0	495.0-1783.3	80785.7	95369.7	33.6	36.3	14.3	84.7	538.7	63.7

NF/USL- No. of fruits/unit shoot length, FS 20 DAFB- Fruit set 20 days after the bloom, FS 40 DAFB- Fruit set 40 days after the bloom, FFBH- Final fruit before harvesting, Yield/P- Yield/plant, MFW- Mean fruit weight, MFL- Mean fruit length, MFB- Mean fruit breadth, FY/USL- Fruit yield/unit shoot length.