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Short Communication

VARIABILITY AND ASSOCIATION STUDIES IN HOPS (*HUMULUS LUPULUS* L.)

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Hops are used by the brewing industry to impart desirable, bitter and aromatic taste and sparkle to the beer. Being photo-controlled plant, its cultivation is restricted to about 32 countries having temperate climate. Hops got established as a new cash crop in Kashmir and some parts of Himachal Pradesh (Bakshi and Atal, 1985). Different varieties were successfully cultivated on large scale. The present study was undertaken to determine the variability parameters, heritability and correlation between various quantitative traits of 28 genotypes.

Twenty-eight entries comprising 24 hop genotypes bearing pedigree Nos. RRL(H) 17 x Q57-2, RRL(H) 17 x Q63-8, RRL(H) 17 x Q63-14, RRL(H) 9 x Q49-8, RRL(H) 17 x Q57-6, RRL(H) 9 x Q49-1, RRL(H) 9x Q57-14, RRL(H) 7 x Q57-1, RRL(H) 7 x Q57-2, RRL(H) 7 x Q57-3, RRL(H) 9 x Q18-9, RRL(H)6, RRL(H)54, RRL(H)20-13, RRL(H)4-60, RRL(H)4-111, PL208, PL246, PL320, PL324, PL433, PL442, PL576, PL597, and four standard varieties like *Late Cluster*, *Talisman*, *Comet*, *Hybrid-2* were incorporated in this study. These entries were grown in randomised block design with four replications at the experimental field of Regional Research Laboratory, Srinagar Branch, in the year 1987. Each plot consisted of five 10m long rows, spaced 2 m apart. Plant to plant distance was also kept 2m. The plants were trained in upright system with 4 bines per plant under 5.18 m high trellis. Observations were recorded on 10 randomly selected plants per plot in the year 1988 and 1989. The parameters included days to maturity, days to bines reaching top wire, length of laterals (cm), cone width (cm), number of cones per node on lateral, strig length (cm), number of floral axis on cone strig, oil (ml/100g), alpha acids (%), 100 cone weight (g). The pooled data for two years were subjected to analysis of variance (Panse & Sukhatme, 1957). Phenotypic, genotypic coefficient of variation; heritability and correlations were worked out as per standard procedure.

A wide range of variation was observed in number of characters. The range of alpha acids varied from (3.0-12.2) per cent with a mean value of 7.83 per cent. The weight of 100 cones and length of laterals varied from 50.0-122.0 g with an average value of 90.0 g and 51.8-146.92 cm with a mean value of 101.10 cm, respectively. It takes an average of 52.37 days for the bines to reach to top wire and 64 days for cones to mature from the date of burr initiation. The genotypic coefficient of variation was maximum for alpha acids (41.10), minimum for maturity days of cones (5.56) and days for bines to reach to top wire (3.94) (Table 1). Characters showing low genotypic coefficient of variation indicate

Table 1. Mean, range, coefficient of variability and heritability in hops

Characters	Mean	Range	Co-efficient of variability		Heritability (%)
			Pheno-typic	Geno-typic	
Maturity days	64.0	57-72	10.49	5.56	28.08
Bines reaching top wire (days)	52.37	49-56	5.96	3.94	43.56
Length of lateral (cm)	101.10	51.80-146.92	33.0	32.98	99.90
Cone width (cm)	2.28	1.90-2.90	5.63	11.28	51.47
Number of cones/ node on laterals	7.25	4-10	28.70	28.40	97.73
Strig length (cm)	2.38	1.8-2.9	16.94	15.42	82.85
No. of floral axis on cone strig	9.37	7.0-12.80	21.53	21.29	97.77
Oil (ml/100 g)	0.57	0.32-0.87	42.75	31.47	54.17
Alpha acids (%)	7.83	3-12.20	41.21	41.10	99.45
100 cone weight (g)	90.00	50-122	25.73	24.58	91.22

that they were more influenced by the environment. Also little difference was observed between phenotypic and genotypic coefficient of variability in the alpha-acids, number of floral axis on cone strig, number of cones per node, 100 cone weight and length of laterals indicating that these characters respond less to environmental factors. The percentage of heritability in the broad sense was the highest for length of laterals (99.90), alpha-acids (99.45), number of floral axis on cone strig (97.77), number of cones per node on laterals (97.73) and 100 cone weight (91.22), and the lowest for maturity days of cones (28.08),

Table 2 : Correlation coefficients of various characters in hops

Characters	Bines reaching top wire (days)	Cone width (cm)	100 cone weight (g)	Number of cones/node on laterals	Length of laterals (cm)	Strig length (cm)	Number of floral axis on cone strig	Alpha acids (%)	Oil (ml/100g)
Maturity days	-0.1138	-0.1028	-0.0826	-0.0567	0.1967	0.4531	0.5970	0.1585	-0.2768
Bines reaching top wire (days)		-0.3664	0.0204	-0.6307	0.6604*	-0.1609	-0.3186	-0.4008	0.1666
Cone width (cm)			-0.2572	0.1807	-0.2881	-0.2879	-0.3914	-0.3974	0.0202
100 cone weight (g)				-0.0561	0.0543	0.2973	-0.0251	-0.5958	0.1409
No. of cones/node on laterals					-0.3921	0.0328	0.1724	0.6291	-0.6565*
Length of laterals (cm)						-0.3297	-0.4737	-0.7077*	-0.0291
Stig length (cm)							0.7541*	0.0069	-0.869
No. of floral axis on cone stig								0.2334	0.0171
Alpha acids (%)									0.0054

*Significant at 5%

and days to reach to top wire (43.56). Characters having high heritability value could be directly improved by selection since they are less affected by environment. Simple correlation was worked out between various characters. Most of the correlations were not significant. However positive and significant correlation was obtained between length of laterals and days for bines to reach to top wire (r=0.6604), strig length and number of floral axis on cone strig (r= 0.7541). A negative and non-significant correlation was observed between 100 cone weight and alpha acid content (r= -0.5958) which confirms earlier findings (Haunold *et al.*, 1983). It has also been reported that high alpha acid content and high cone yield are independent genetic traits (Haunold *et al.*, 1982; Romanko *et al.*, 1979). A negative and significant correlation was obtained between oil (ml/100g) and number of cones per node on laterals (r=0.7077) (Table 2). The negative correlation may be attributed to size and number of cones per node. With the absence of significant correlation, it would be possible to select lines in these crosses which are high yielding and are of superior quality.

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