Vegetable Science (2012) 39 (2) : 183-185

Interrelationship among components of lodging and yield in pea (*Pisum sativum* L.)

AK Singh, N Tyagi and CP Srivastava

Received : January, 2012 / Accepted : August, 2012

Pea (*Pisum sativum* L.) is one of the six major pulse crops cultivated globally and is the second highest yielding legume in the world after common bean, *Phaseolus vulgaris* L. (FAO database, 2010). Pea has been grown as an important source of human food and animal feed for many centuries. Similar to other pulse crops, pea is also prone to different biotic and abiotic stresses causing substantial yield losses. In addition, lodging is also a major constraint in pea production. Lodging usually referred to a condition in which the stems of plants bend at or near the surface of the ground, which could lead to the collapse of the canopy. Lodging enhances the canopy microclimate for fungal disease development, reduces photosynthetic ability of the plants, reduces harvest efficiency and increases harvest cost. For such reasons, lodging can cause upto 74% yield loss in some dry pea cultivars (Amelin and Parakhin 2003). In view of this, concerted efforts are needed to enhance pea productivity by selecting genotypes with high standability and stable yield. The present investigation was undertaken to assess the nature of association among lodging resistance and yield and yield related components in pea.

For the present experiment fifty-six diverse pea genotypes were sown in randomized block design with three replications at Agricultural Research Farm, Institute of Agricultural Science, Banaras Hindu University, Varanasi during Rabi season 2008-09. Each genotype was grown in a 5 row plot of 4m length. Row-to- row and plant-to- plant distance was maintained at 30 cm and 10 cm, respectively. Recommended agronomic practices and plant protection measures were followed to raise a good crop. After eliminating the border plants, observations were recorded on five randomly chosen plants from each plot, replication wise on ten quantitative characters *viz*., days to flowering (DF), days to maturity (DM), plant height (PH), number of primary branches (NPB), pods per plant (PPP), 100- seed weight (TW) and seed yield per plant (SYPP), stem diameter (SD), internode of first bent (IFB) and lodging score (LS). Among the components of lodging, stem diameter was recorded in millimetre (mm) using Vernier Calipers at first, tenth and first flower bearing internode. The internode of first bent was recorded as the internode where the plant had bent first. Assessment of lodging score was made at physiological maturity using a 1-9 scale (Wang *et. al.,* 2006); where, 1 = main stems strictly upright, 2 = main stems incline slightly, 3 = main stems at 60° angle, 4 = main stems at 45° angle, 5 = main stems at 30° angle, 6 = 1/2 of the main stems flat, 7 = 2/3 of the main stems flat, 8 = 4/5 of the main stems flat and 9 = all main stems flat. Statistical analyses were performed using INDOSTAT software.

The effect of lodging is evident from the differences in lodging resistant and susceptible genotypes. On the basis

Table 1. Range and mean of different characters in eleven lodging resistant and forty five susceptible pea genotypes.

Traits	Lodging resistant		Lodging susceptible	
	Range	Mean ± SE	Range	Mean ± SE
DF*	60.33 – 70.0	65.18 ± 0.92	58.67 – 76.33	67.53 ± 0.55
DM	101.33 – 113.0	105.91 ± 1.16	105.0 – 125.0	113.79 ± 0.75
PH	40.40 – 64.23	54.41 ± 2.45	31.51 – 161.50	100.35 ± 5.86
NPB	2.15 – 3.80	2.88 ± 0.17	1.723 – 3.73	2.71 ± 0.08
PPP	5.37 – 19.02	14.06 ± 1.36	2.38 – 19.44	10.45 ± 0.66
TW	2.87 – 5.50	4.02 ± 0.23	2.11 – 5.75	3.41 ± 0.12
SYPP	3.31 – 9.96	7.01 ± 0.69	1.2 – 10.54	5.07 ± 0.30
SD	0.27 – 0.47	0.38 ± 0.02	0.31 – 0.53	0.38 ± 0.007
IFB	5.60 – 13.03	8.17 ± 0.64	5.63 – 14.5	10.81 ± 0.30
LS	1.33 – 2.67	1.94 ± 0.14	3.33 – 9.0	6.14 ± 0.24

* DF = days to flowering, DM = days to maturity, PH = plant height (cm), NPB = number of primary branches, PPP = pods per plant, TW = 100-seed weight (g), SYPP = seed yield per plant (g), SD = stem diameter (mm), IFB = internode of first bent and LS = lodging score

AK Singh, N Tyagi and CP Srivastava
Department of Genetics and Plant Breeding, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi- 221 005
Email: cpsgenetics@gmail.com

Table 2. Phenotypic correlation coefficients among ten characters in 11 lodging resistant and 45 lodging susceptible pea genotypes.

Characters	DM	PH	NPB	PPP	TW	SYPP	SD	IFB	LS
DF[@]	0.414*	0.172	0.342*	0.181	0.329*	0.040	-0.088	-0.287	-0.445**
	(0.571**)	(0.197)	(-0.169)	(-0.122)	(0.026)	(-0.002)	(0.144)	(0.240)	(0.176)
DM		-0.018	0.131	0.131	0.541**	0.503**	0.185	0.295	-0.176
		(0.287)	(-0.068)	(-0.162)	(-0.310*)	(-0.208)	(-0.037)	(0.142)	(0.373*)
PH			0.353*	0.477**	0.334*	0.506**	0.597**	-0.210	-0.369*
			(0.135)	(0.319*)	(0.031)	(0.268)	(-0.027)	(0.500**)	(0.340*)
NPB				0.208	-0.027	0.345*	0.372	-0.456	0.061
				(0.378*)	(-0.043)	(0.290)	(-0.275)	(-0.024)	(0.142)
PPP					0.516**	0.870**	0.755**	-0.003	-0.254
					(0.367*)	(0.658**)	(0.088)	(0.239)	(-0.220)
TW						0.325*	0.312*	0.060	-0.318*
						(0.624**)	(0.373*)	(0.144)	(-0.300*)
SYPP							0.858**	0.112	-0.206
							(0.057)	(0.307*)	(-0.215)
SD								-0.116	-0.313*
								(-0.118)	(0.072)
IFB									-0.232
									(0.176)

[@] DF = days to flowering, DM = days to maturity, PH = plant height (cm), NPB = number of primary branches, PPP = pods per plant, TW = 100-seed weight (g), SYPP = seed yield per plant (g), SD = stem diameter (mm), IFB = internode of first bent and LS = lodging score
Values in parentheses indicate the phenotypic correlation coefficients among lodging susceptible genotypes.

of mean values of lodging resistant and susceptible genotypes, all the lodging resistant genotypes (LS< 3) belonged to the dwarf group and *vice-versa* (Table 1). Mean height of lodging susceptible genotypes (100.35cm) was nearly two-times the height of lodging resistant genotype i.e., 54.41cm. This confirms that plant height has negative effect on resistance to lodging and it is because of their short stature that gives them an advantage over the tall genotypes. The lodging resistant genotypes also had other desirable components of yield i.e., more number of pods per plant and higher 100-seed weight then susceptible genotypes. The resistant genotypes were early for days to flowering and days to maturity, showing that earlier the maturity of a plant, lesser is the chance that plant will lodge. Although, number of primary branches, internode of first bent and stem diameter were almost comparable in lodging resistant and susceptible genotypes studied. Vasileva *et al*. (1980) also reported that dwarf cultivars had greater lodging resistance than tall cultivars. The reason may be the difference in the length of internodes between the tall and dwarf genotypes. Short internodes are characteristic of dwarf genotypes.

Data on phenotypic correlation coefficient among ten characters in lodging resistant and susceptible genotypes of pea has been presented in table 2. Among the 11 genotypes that are lodging resistant, significant and negative correlation coefficient estimates were obtained between lodging score and days to flowering, plant height, 100-seed weight and stem diameter. In the remaining 45 lodging susceptible genotypes, days to maturity with days to flowering and lodging score, seed yield per plant with pods per plant and 100-seed weight, plant height with internode of first bent and, 100- seed weight with stem diameter were significantly and positively correlated. This implies that genotypes with late flowering and late maturity were more prone to lodging. 100-seed weight had positive and significant correlation estimates with pods per plant but it was negatively correlated with days to maturity and lodging score. These results are supported by the findings of Taran *et al*. (2003) and Zhang *et al*. (2006). The stem diameter did not show any relationship with lodging resistance, as the correlation coefficients were non-significant which is contrary to the findings on cereals (Keller *et al*., 1999). Similar was the case with correlation estimates of internode of first bent with lodging score. The information obtained from the interrelations among lodging components and yield components will be further utilized in pea breeding programmes for simultaneous improvement of yield potential with more lodging tolerance.

References

Amelin AV and Parakhin NV (2003) Scientific grounds for pea selection for fodder production. Kormoproizvodstvo 2: 20-25. Abstract from CAB Abstract AN: 20033049804. CAB International, Wallingford, UK.

FAO database (2010) Food Agriculture Organization Database. http://www.faostat.fao.org. Accessed on 25 September 2010.

Keller M, Karutz CH, Schmid JE, Stamp P, Wainzeler M, Keller B and Messmer MM (1999) Quantitative trait loci for lodging resistance in a segregating wheat×spelt population. Theor Appl Genet 98: 1171-1182.

Taran B, Warkentin T, Somers DJ, Miranda D, Vanderberg A, Blade S, Woods S, Bing D, Xue A, DeKoeyer D and Penner G (2003) Quantitative trait loci for lodging resistance, plant height and partial resistance to *Mycosphaerella* blight in field pea (*Pisum sativum* L.). Theor Appl Genet 107: 1482-1491.

Vasileva M, Ancheva M and Vassileva M (1980) Genetical and biochemical analysis of stem mutants of peas. Genet Sel 13: 3-18.

Wang TF, Gossen BD and Slinkard AE (2006) Lodging increases severity and impact of mycosphaerella blight on field pea. Canadian J Plant Sci 86: 855-863.

Zhang C, Taran B, Warkentian T, Tullu A, Bett KE, Vandenberg B and Somers DJ (2006) Selection for Lodging Resistance in Early Generations of Field Pea by Molecular Markers. Crop Sci 46: 321-329.