type genotypes with respect to grain yield, drought and cold tolerance and disease resistance. In general, the spring x winter wheat combinations proved to be better than their reciprocals indicating the significant difference between the effect of the cytoplasm of the two ecotypes (Choudhary, 1996).

Out of 30 spring type derivatives of winter x spring wheat and their reciprocals, two genotypes *viz.*-'KWS 22' and 'KWS 29' were observed as very high yielding, drought tolerant, resistant to yellow and brown rusts and powdery mildew and medium bold amber grained. Both these lines have been included in the National Integrated Disease Screening Nursery (IDSN) and if found resistant, will be included in the Initial Varietal Trials for rainfed and timely sown conditions of northern hill zone proposed and conducted under All India Coordinated Wheat Improvement Project.

Although, by exploiting the off-season facilities of Kukumseri (Lahaul and Spiti) the time period required for attaining the homozygosity in the segregating generations was reduced to half yet some other innovative breeding approaches *viz.*- androgenesis–mediated and wheat x maize systems are being executed for the transfer of winter wheat traits into spring wheats in a single step through the development of polyhaploids and doubled haploids, which in turn, further shorten the breeding cycle. For this purpose, an *ad-hoc* research project entitled "Genetic amelioration of winter and spring wheat ecotypes through androgenesis and wheat x maize systems" has been sanctioned by the ICAR and being executed since 1997 at the Department of Plant Breeding and Genetics, HPKV, Palampur.

The present endeavour being executed for the spring wheat improvement has been made sustainable by conserving the most endangered winter wheat landraces collected from the snow-bound regions of North-West Himalayas. Besides, certain elite exotic winter wheat collections of diverse origin are also being introduced and conserved under naturally prevailing cold and dry conditions at HPKV, RRS, Kukumseri (Lahaul and Spiti) for the future sustainable use and posterity. Every year, the crosses between the winter and spring wheats are planned according to the need of the different hill regions of North-West Himalayas, attempted during the off-season at Kukumseri (Lahaul and Spiti), evaluated during the main season at Palampur and advanced in the shuttled breeding programme by exploiting the off-season facilities available in the high-hills of Himachal Pradesh.

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Correlation and Path Coefficient Analysis in Walnut (*Juglans regia* L.)

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Key Words: Correlation, *Juglans regia*, Walnut

A total of 133 walnut seedlings were used to study the association between nut weight and its attributes. Nut weight was significantly and positively correlated with nut width, nut height, nut thickness, pad width, shell thickness and kernel weight. Path analysis of nut weight and its components revealed that nut width, nut height, nut thickness, shell thickness and kernel weight had direct positive effect on nut weight.

Nut weight is an important character for in-shell marketing of nuts. The nut weight depends on many characters and selection is more effective when based on component characters which are highly heritable and

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positively correlated. When more number of variables are considered in correlation the association becomes more complex and less obvious. The use of path coefficient analysis is helpful under such situation. This analysis shows the direct and indirect associations and reveals the most reliable nut weight contributing characters. In walnut, there is wide range of variability due to seed propagation. This variability provides a great scope for improving fruit weight through a systematic and planned selection programme for one or more direct or indirect nut weight components. Keeping in view the facts explained above, the present investigation was undertaken to determine the nature and degree of association among the characters and their direct and indirect effects on nut weight.

The present study was conducted in Chamba and Kullu districts of Himachal Pradesh. Data was recorded on 133 walnut seedling trees. Twenty sun dried randomly selected nuts were used for recording data on nut characters. The correlation coefficients were calculated as per methods given by Panse and Sukhatme (1985). The path analysis was performed according to the methods followed by Dewey and Lu (1959).

Correlation among various nut and kernel characters were worked out at phenotypic level and results are presented in Table 1.

Nut weight had positive and significant association with nut width (0.589), nut height (0.403), nut thickness (0.618), pad width (0.472), shell thickness (0.319) and kernel weight (0.772). However, it was found significantly and negatively associated with kernel recovery (-0.202). Nut width showed positive and significant correlation with nut height (0.483), nut thickness (0.783), pad width (0.350) and kernel weight (0.521). Similarly nut height showed positive and significant correlation with nut thickness (0.292), pad width (0.209), kernel weight (0.362). Nut thickness showed significant positive correlation with pad width (0.236), pad thickness (0.245) and kernel width (0.535). Pad width showed significant positive correlation with shell thickness (0.416) and kernel width (0.233) while significant negative correlation with kernel recovery (-0.324). Shell thickness had significant negative correlation with kernel recovery (-0.314). Kernel weight had significant positive correlation with kernel recovery (0.437).

In path analysis, 7 different nut and kernel characters were considered as causal variables and nut weight was taken as a dependent variable. The direct and indirect effects of various characters were worked out at phenotypic level and presented in Table 2. The direct positive effects of various traits on nut weight can be arranged in a descending order, nut width (0.0459), nut height (0.0358), nut thickness (0.0413), shell thickness (0.0807), kernel weight (0.9764) while direct negative effects were found with pad width (-0.0105) and kernel recovery (0.6090). Nut weight had positive and significant relationship with nut width, nut height, nut thickness, pad width, shell thickness and kernel weight. The significant positive correlation between different pairs can be helpful for the improvement of different characters in a single step if the higher or lower value of each is required, while the negatively associated traits where increased or decreased value of both the characters is required cannot be improved in a single step. The character which had non-significant correlation suggest that they are independent of each other. The present correlation results

Table 1. Coefficients among various nut and kernel characters in seedling trees of Persian walnut

Characters	1	2	3	4	5	6	7	8	9
Nut weight	1.000								
Nut width	0.589*	1.000							
Nut height	0.403*	0.483*	1.000						
Nut thickness	0.618*	0.708*	0.292*	1.000					
Pad width	0.472*	0.350*	0.209*	0.236*	1.000				
Pad thickness	0.125	0.016	-0.082	0.245*	-0.046	1.000			
Shell thickness	0.319*	0.029	0.059	0.064	0.416*	0.105	1.000		
Kernel weight	0.772*	0.521*	0.362*	0.555*	0.223*	0.093	0.051	1.000	
Kernel recovery	-0.202*	0.018	0.022	0.018	-0.324*	-0.013	-0.314*	0.437*	1.000

*Significant at p=0.05

Table 2. Direct and indirect effect of various nut kernel characters on nut weight in seedling trees of Persian walnut

S. No.	Characters	1	2	3	4	5	6	7
1.	Nut width	0.0459	0.0173	0.0292	-0.0037	0.0023	0.509	-0.0108
2.	Nut height	0.0221	0.0358	0.0120	-0.002	-0.0047	0.3535	-0.0131
3.	Nut thickness	0.0325	0.0105	0.0413	-0.0025	0.0052	0.5419	-0.0111
4.	Pad width	0.0160	0.0075	0.0097	-0.0105	0.0336	0.2180	0.1975
5.	Shell thickness	0.0013	-0.0021	0.0026	-0.0024	0.0041	0.9764	-0.2661
6.	Kernel weight	0.0239	0.0130	0.0229	-0.0024	0.0041	0.9764	-0.2661
7.	Kernel recovery	0.0008	0.0008	0.0008	0.0034	-0.0254	0.4266	-0.6090

Residual effect = 0.0354

are in agreement with the results obtained by Sharma (1999) in similar type of study.

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Sustenance of Production of Rajmash – A Cash Crop of the Dry and Wet Temperate Regions of North-West Himalayas

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Key Words: French bean, Evaluation, Landraces, Temperate region

The dry and wet temperate region of North-West Himalayas are endowed with huge variability in respect of French bean (*Phaseolus vulgaris*) – an important pulse crop of these zones. It is being cultivated during summers as mixture of different landraces, which in turn, hampers the grain yield production of the crop. Besides, certain other constraints such as disease susceptibility, asynchrony in flowering and maturity and shattering susceptibility also reduce the average production drastically. Lack of uniformity in seed size and colour fetches poor premium in the market. Therefore, keeping in view the aforesaid constraints, a systematic breeding programme was planned for the genetic amelioration of *rajmash* – a most important precious pulse crop, which can play a significant role in improving the economy of the farmers of the hill regions of North-West Himalayas.

Almost all the regions especially tribal tracts of the dry and wet temperate regions of North-West Himalayas were explored during the years 1987-1989 and 400 different landraces were collected. This germplasm was subjected to pure line selection breeding procedure for developing improved varieties for the high-hills of the North-West Himalayas. Simultaneously, the genetic resources were preserved by utilizing the naturally prevailing cold and dry conditions in the tribal areas of the zones.

All the landraces of *rajmash* were divided into two groups *viz.*- determinate (bush type) and indeterminate (pole type). The former group covers a larger area in the dry and wet temperate zones of North-West Himalayas, hence the improvement programme was also initiated in the same group of *rajmash* during the year 1989 at HPKV, Regional Research Station, Kukumseri (Lahaul and Spiti).