Correlation and path analysis for seed yield and its attributing traits in mung bean genotypes [Vigna radiata (L.) Wilczek)]

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Abstract

An experiment has been conducted at the Agricultural Research Field of Department of Genetics and Plant Breeding, Rama University, Kanpur, during Kharif session 2023, understand the pattern of genetic variability and heritability through the investigation of 24 mung bean genotypes including checks. The study reveals diverse traits among mung bean genotypes. The Days to 50 flowering (DFF) range from 49.333 to 53.333 days, with some genotypes, like IPM 02 - 03, flowering earlier, and others, like NM - 1 (Dull), later. Plant heights (PH) vary from 50.999 to 95.667 centimetres, with IPM 302 - 2 exhibiting taller plants and China Mung - 2 shorter ones. Primary branches per plant (PB) range from 1.900 to 4.067, with IPM 205 - 7 having fewer and EC 496839 more branches. Secondary branches per plant (SB) vary from 5.667 to 10.000, with IPM 205 - 7 having fewer and NM - 1 (Dull) more branches. Cluster count per plant ranges from 5.600 to 10.933, with China Mung - 2 having fewer and BDY - R2 more clusters. Pod count per plant ranges from 12.433 to 31.533, with IPM 02 - 03 having fewer and Choti Mung - 1 more pods. Days to maturity (DM) vary from 67.000 to 86.000 days. Pod length (PL) ranges from 6.533 to 9.400 centimetres. Seeds per pod (SP) vary from 2.577 to 8.713, and 100-seed weight (SW) ranges from 2.577 to 16.840 grams. Seed yield per plant (SY) varies from 8.607 to 16.840 grams. Biological yield (BY) ranges from 37.667 to 55.000 kg/ha, and Harvest Index (HI) from 18.300% to 37.767%. These findings offer insights into mung bean diversity, aiding breeding and cultivation strategies for enhanced productivity and resource efficiency. The genotypic correlation matrix for mungbean traits highlights key relationships: early flowering correlates with faster maturity and higher seed counts per pod, taller plants tend to have more primary branches but fewer secondary branches and lower seed yields, and a higher number of pods per plant significantly contributes to overall harvestable yield.

Keywords: Geneticvariability,Correlation, heritability,geneticadvancemungbean

Introduction

Pulses serve as a vital source of dietary protein for a significant portion of the world's vegetarian population. With an average protein content ranging from 20 to 30%, pulses offer roughly 2.5 to 3.0 times more protein than cereals. Globally, the food supply comprises 71 million tonnes and spans 79 million hectares of pulses (Anonymous, 2021) [3]. India ranks third in pulse cultivation, with approximately 4.5 million hectares of land dedicated to pulse production, yielding a total of 2.5 million tonnes (Anonymous, 2021) [3]. Among pulses, the mung bean holds particular significance in Asian countries, with India leading as the world's largest producer and consumer, contributing 22% to global output and 33% to overall production. Following Red Gram and Chickpea, mungbean stands as the third most crucial pulse crop. Thriving in warm-season climates, particularly in Asia, mungbean cultivation extends across dry and semi-arid tropics, flourishing in hot and humid conditions (Kulkarni and Pandey, 1988; Pannu and Singh, 1988) [9, 13]. Mung bean (Vigna radiata L. Wilczek) assumes a pivotal role in Indian agriculture as one of the most significant pulse crops. Notably, mung bean protein enriches various food preparations, a nutrient profile unmatched by cereals. Sprouted mung beans offer exceptional nutritional value akin to asparagus or mushrooms, as indicated by USDA and NIH data (2022) [18]. Sprouting enhances thiamine, niacin, and ascorbic acid concentration. The nutritional value of mung bean lies in its high-quality, easily digestible protein, as reported by Saleem et al. (1998) [16], who highlighted total protein, amino acids, crude fibre, and lipid components in the seeds.

Seed yield, being a dependent trait, is influenced by numerous independent characteristics. Understanding the correlations between these traits and their direct and indirect effects on seed yield is crucial for selecting desirable attribute Muthuswamy et al. (2019) [12]. Consequently, our study aimed to analyse eight key traits and their impact on Mung bean genotypes. Correlation and path analyses revealed the significance of certain traits, particularly plant height, pod length, and test weight, which exhibited positive correlations with seed yield at both genotypic and phenotypic levels. Path analysis further highlighted the substantial direct effect of days to maturity, pod length, and seed yield per hectare due to their strong correlations and high direct effects. This underscores the potential for enhancing seed yield through the selective breeding of these traits. Correlation analysis in mung bean indicates significant associations between seed yield and various yield-contributing traits. Studies show positive correlations between seed yield and traits like plant height, pod length, number of seeds per pod, and test weight. Additionally, traits such as number of pods per plant, number of seeds per pod, and 100 seed weight exhibit positive correlations and direct effects on seed yield, suggesting their importance in mung bean improvement programs Mohammad, et al. (2023). [11] Furthermore, the number of seeds per pod, biological yield per plant, harvest index, and seed index demonstrates positive direct effects on seed yield per plant in greengram, emphasizing their significance in selecting high- yielding genotypes Syed and Rahman. (2023) [10]. These findings underscore the importance of considering multipletraits for enhancing seed yield in mung bean cultivation. Gangalapuram, et al. (2022) [7]. Correlation coefficient analysis facilitates understanding the mutual association among plant characteristics, identifying traits pivotal for yield enhancement. Strong positive correlations between traits expedite genetic progress, while negative correlations may impede advancement. Hence, the experiment aimed to explore the relationship between seed yield and yield- contributing characters. Khatik et al. (2022) [4].

Material and Methods

The present investigation was carried out at the research farm of Faculty of Agricultural Sciences and Allied industries, Mandhana, Rama university, Kanpur-209217on 24 (Table 1) diverse genotypes of mung bean including one check entry (Samtar), in RBD field experimental design with 3 replications. Data of 12 quantitative traits, including Days to 50% flowering (DFF), Days to maturity (DM), Number of primary Branches (PB), Secondy branches per plant (SB), Plant height (PHT) (cm), Pod length (PL), Seeds/ Pods (SPP), Biological yield per plant (BY), 100 seed weigh (SW) (g), Harvest index % (HI %), and Grain yield per plant (in grams). Data have been recorded from the 5 randomly selected plant from each replication and mean have been calculated and data have been subjected to various statistical analysis for result and report writing. Genotypic and phenotypic correlations were determined following Fisher's method (1954) [6], respectively. Path analysis was conducted according to the approach outlined by Dewey and Lu (1959) [5].

Results and Discussion

Genotypic and phenotypic correlation coefficient Analysis:

Days to 50 Flowering (DFF) is negatively correlated with Plant Height (PH) and Days to Maturity (DM), suggesting that faster flowering varieties tend to be shorter and mature quicker. Plant Height (PH) shows a strong positive correlation (Table 2) with Primary Branches per Plant (PB), indicating that taller plants tend to have more primary branches. Primary Branches per Plant (PB) is negatively correlated with Seeds per Pod (SP) and Days to Maturity (DM), which might suggest that plants with more branches mature slower and have fewer seeds per pod. Secondary Branches per Plant (SB) has a positive correlation with Seeds per Pod (SP), indicating that more secondary branches might contribute to higher seed counts per pod. Pods per Plant (PPP) shows a strong positive correlation with Harvest Index (HI), highlighting that more pods per plant are associated with a higher proportion of harvestable yield. Pod Length (PL) and Seed Yield per Plant (SY) are negatively correlated, suggesting that longer pods might not necessarily translate to higher seed yield. Seeds per Pod (SP) has a strong negative correlation with Harvest Index (HI), indicating that a higher number of seeds per pod may lead to a lower overall harvest efficiency. These insights can guide breeding and cultivation strategies to optimize thegrowth and yield of mungbean by focusing on the traits that most significantly impact productivity.

Genotypic (rg) and phenotypic (rp) correlation coefficients between yield and growth component characters in mungbean:

The genotypic correlation matrix for mungbean traits reveals several key relationships that are crucial for understanding the genetic architecture of this crop. Days to 50% flowering (DFF) is significantly negatively correlated (Table 3) with Days to Maturity (DM), suggesting that varieties that flower earlier tend to mature faster. This trait also shows a positive correlation with Seeds per Pod (SP), indicating that early flowering may be associated with higher seed counts per pod. Plant Height (PH) is positively correlated with Primary Branches per Plant (PB), indicating that taller plants generally have more branches, but it shows a negative correlation with Secondary Branches per Plant (SB) and Seed Yield per Plant (SY), suggesting that taller plants may not necessarily produce more secondary branches or higher seed yields. Primary Branches per Plant (PB) negatively correlates with Seeds per Pod (SP), suggesting a trade-off between branching and seed count per pod. Pods per Plant (PPP) exhibits a very strong positive correlation with Harvest Index (HI), highlighting that a higher number of pods significantly contributes to the overall harvestable yield.

The results for the Days to 50 flowering (DFF) trait across various mung bean genotypes reveal a range of durations for reaching this developmental stage (Table 4.). Genotypes such as IPM 02 - 03, IPM 302 - 2, and ML 1059 exhibited relatively shorter durations, with DFF values of 49.333, 50.333, and 48.667 days, respectively. On the other hand, genotypes like NM - 1 (Dull) and China Mung - 2 displayed longer durations, with DFF values of 53.333 and 53.000 days, respectively. The mean DFF value across all genotypes was calculated to be 49.861 days, with a minimum of 43.333 days and a maximum of 53.333 days.

The plant heights vary across the different genotypes, ranging from 50.999 to 95.667. These measurements reflect the diversity in plant height observed within the mung bean population. Genotypes such as IPM 302 - 2 exhibit relatively taller plants, with a height of 84.200, while others like China Mung - 2 and EC 520034 have comparatively shorter plants, measuring 53.100 and 52.633, respectively. The mean plant height across all genotypes is calculated to be 72.121.

The number of primary branches per plant varies across the different genotypes. The values range from 1.900 to 4.067. Some genotypes, such as IPM 205 - 7 and HUM - 1, have a lower number of primary branches per plant, measuring 1.900 and 2.767, respectively. Conversely, genotypes like EC 496839 and EC 520014 exhibit a higher number of primary branches, with values of 3.367 and 4.067, respectively. The mean number of primary branches per plant across all genotypes is calculated to be 2.968. The number of secondary branches per plant also displays variation among the different genotypes. The values range from 5.667 to 10.000. Some genotypes, like IPM 205 – 7and Shikha (extra early), have a lower number of secondary branches per plant, measuring 5.667 and 6.667, respectively. Conversely, genotypes such as NM - 1 (Dull) and EC 496839 exhibit a higher number of secondary branches, with values of 10.000 each. The mean number of secondary branches per plant across all genotypes is calculated to be 7.653. These variations highlight the genetic diversity in mung bean plants regarding the number of secondary branches, which can contribute to overall plant architecture and yield potential.The cluster per plant data showcases notable diversity among the different genotypes, with values ranging from 5.600 to 10.933. Some genotypes, like China Mung - 2 and Shikha (extra early), have a lower cluster count per plant, measuring 5.600 and 5.870, respectively. Conversely, genotypes such as BDY - R2 and KM 11 - 584 exhibit a higher cluster count, with values of 10.933 each. The mean cluster count per plant across all genotypes is calculated to be 8.054.

The number of pods per plant varies significantly among the different genotypes, with values ranging from 12.433 to31.533. Some genotypes, like IPM 02 - 03 and IPM 05 - 3 - 22, have a lower pod count per plant, measuring 15.933 and 14.667, respectively. Conversely, genotypes such as Choti Mung - 1 and EC 520034 exhibit a higher pod count, with values of 29.333 and 31.533, respectively. The mean pod count per plant across all genotypes is calculated to be 19.322.The days to maturity (DM) for the different genotypes exhibit variability, with values ranging from 67.000 to86.000. Some genotypes, such as IPM 02 - 03 and IPM 05 -3 - 22, have a relatively shorter duration to maturity,measuring 79.667 and 82.333 days, respectively. Conversely, genotypes like NM - 1 (Dull) and EC 520034 require a longer duration to reach maturity, with values of86.000 days each. The mean days to maturity across all genotypes is calculated to be 80.264 days.The pod length (PL) data for the different genotypes shows variability, with measurements ranging from 6.533 to 9.400 cm. Some genotypes, like IPM 99 - 01 - 10 and Bhutan ML- 2, have shorter pod lengths, measuring 6.533 and 6.867 cm, respectively. Conversely, genotypes such as KM 11 - 584 and HUM - 1 exhibit longer pod lengths, with values of9.400 and 9.170 cm, respectively. The mean pod length across all genotypes is calculated to be 7.769 cm.

The number of seeds per pod (SP) varies across different genotypes, with values ranging from 2.577 to 8.713. Some genotypes, like EC 520014 and K - 851, exhibit lower seed counts per pod, measuring 2.577 and 4.410 seeds, respectively. Conversely, genotypes such as ML 1059 and IPM 302 - 2 demonstrate higher seed counts per pod, with values of 8.713 and 7.713 seeds, respectively. The mean number of seeds per pod across all genotypes is calculated to be 6.991. The 100-seed weight (SW) data for different genotypes varies significantly, with measurements ranging from 2.577 to 16.840 grams. Some genotypes, such as NM - 1 (Dull) and EC 520014, display lower 100-seed weights, measuring 2.577 and 2.987 grams, respectively. On the other hand, genotypes like ML 1059 and IPM 99 - 01 - 10 exhibit higher 100-seed weights, with values of 16.840 and4.290 grams, respectively. The mean 100-seed weight across all genotypes is calculated to be 3.693 grams.The seed yield per plant (SY) data for various genotypes ranges from 8.607 to 16.840 grams. Genotypes like NM - 1 (Dull) and EC 520014 demonstrate lower seed yields per plant, measuring 8.607 and 9.373 grams, respectively. Conversely, genotypes such as ML 1059 and IPM 02 - 03 display higher seed yields per plant, with values of 16.840 and 9.340 grams, respectively. The mean seed yield per plant across all genotypes is calculated to be 10.361 grams. The biological yield (BY) data for various genotypes ranges from 37.667 to 55.000 kilograms per hectare (kg/ha). Genotypes such as IPM 302 - 2 and China Mung - 2 exhibit lower biological yields, measuring 37.667 and 38.000 kg/ha, respectively. On the other hand, genotypes like Bhutan ML -2 and EC 520034 display higher biological yields, with values of 55.000 kg/ha each. The mean biological yield across all genotypes is calculated to be 43.403 kg/ha. These variations underscore the diverse performance of different genotypes in terms of biological yield, reflecting the combined influence of genetic traits and environmental factors on crop productivity. The Harvest Index (HI) values for different genotypes range from 18.300% to 37.767%. Notably, genotypes such as IPM 02 - 03 and IPM 302 - 2 exhibit relatively lower Harvest Index values, measuring 19.247% and 28.887%, respectively. Conversely, genotypes like ML 1059 and Bhutan ML - 2 display higher Harvest Index values, with percentages of 37.767% and 27.670% respectively. The mean Harvest Index across all genotypes is calculated to be 24.233%. The number of primary branches might be developed into more number of pod clusters which resulted in high seed yield per plant. Similar findings were earlier reported by Kadam et al. (2022), Thakur et al. (2018) [17], Parihar et al. (2018) [15], Ghimire et al. (2017) [8], Kritika and Yadav (2017), Das and Barua (2015) [2].

Conclusion

In conclusion, the investigation of 24 mung bean genotypes, including checks, reveals considerable variability and heritability in various traits. Days to 50 flowering (DFF) range from 49.333 to 53.333 days, with some genotypes flowering earlier, like IPM 02 - 03, and others later, such as NM - 1 (Dull). Plant heights (PH) vary from 50.999 to 95.667 centimeters, with IPM 302 - 2 showing taller plants and China Mung - 2 shorter ones. Primary branches per plant (PB) range from 1.900 to 4.067, with IPM 205 - 7 having fewer and EC 496839 more branches. Secondary branches per plant (SB) vary from 5.667 to 10.000, with IPM 205 - 7 having fewer and NM - 1 (Dull) more branches. Cluster count per plant ranges from 5.600 to 10.933, with China Mung - 2 having fewer and BDY - R2 more clusters. Pod count per plant ranges from 12.433 to 31.533, with IPM 02 - 03 having fewer and Choti Mung - 1 more pods. Days to maturity (DM) vary from 67.000 to 86.000 days. Pod length (PL) ranges from 6.533 to 9.400 centimeters. Seeds per pod (SP) vary from 2.577 to 8.713, and 100-seed weight (SW) ranges from 2.577 to 16.840 grams. Seed yield per plant (SY) varies from 8.607 to 16.840 grams. Biological yield (BY) ranges from 37.667 to 55.000 kg/ha, and Harvest Index (HI) from 18.300% to 37.767%. These findings provide valuable insights into mung bean diversity, informing breeding and cultivation strategies for improved productivity and resource efficiency. Additionally, the genotypic correlation matrix highlights key relationships, such as the influence of early flowering on overall yield and the trade-offs between plant height, branching, and seed yield.

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Table 1:Listof genotypes.

Sr. No.	GenotypeName
1	IPM02-03
2	IPM302-2
3	ML 1059
4	IPM05-3-22
5	ChotiMung-1
6	NM-1 (Dull)
7	EC 496839
8	China Mung -2
9	BDY-R2
10	EC 520034
11	Bhutan ML-2
12	IPM205-7
13	EC 520014
14	HUM-1
15	IPM312 - 43K
16	KM11 -584
17	ABL -Early
18	IPM99 -01 -10
19	Co6
20	IPM- 03 - 1
21	K – 851
22	Virat
23	Shikha(extra early)
24	Samrat(check Veriety)

Table 2:Phenotypiccorrelationcoefficientforyieldandyieldcontributingtraits

	DFF	PH	PB	SB	CP	PPP	DM	PL	SP	SW	SY	BY	HI
DFF	1.0000	-0.576**	0.019	0.073	-0.136	-0.029	-0.410**	0.118	0.566**	-0.040	0.115	0.065	-0.173
PH		1.0000	0.797**	-0.138	0.317**	-0.013	0.060	-0.171	0.149	-0.043	-0.296*	-0.166	-0.079
PB			1.0000	0.142	0.061	-0.281*	-0.414**	0.150	-0.464**	0.019	-0.121	0.057	0.032
SB				1.0000	0.219	-0.030	0.051	-0.129	0.246*	0.015	-0.361**	0.164	0.183
CP					1.0000	-0.220	0.200	0.220	-0.023	-0.058	0.356**	-0.252*	0.121
PPP						1.0000	-0.059	0.026	0.237*	0.024	-0.250*	0.071	0.616**
DM							1.0000	0.145	-0.094	0.057	0.224	-0.083	-0.263*
PL								1.0000	0.240*	-0.135	-0.261*	-0.081	-0.002
SP									1.0000	0.125	-0.027	0.041	-0.393**

SW										1.0000	-0.188	-0.140	-0.076
SY											1.0000	0.115	0.093
BY												1.0000	-0.106
HI													1.0000

Table 3: Genotypic Ccorrelationcoefficient foryieldandyieldcontributingtraits

	DFF	PH	PB	SB	CP	PPP	DM	PL	SP	SW	SY	BY	HI
DFF	1.000	-0.537**	-0.243*	0.098	-0.016	-0.127	-0.875**	0.095	0.593**	-0.365**	0.407**	0.076	-0.194
PH		1.000	0.949**	-0.420**	0.363**	0.112	-0.024	-0.291*	0.197	-0.207	-0.292*	-0.388**	-0.170
PB			1.000	0.258*	-0.123	-0.593**	-0.391**	0.119	-0.690**	0.002	-0.149	0.071	-0.043
SB				1.000	0.352**	-0.348**	0.176	-0.108	0.296*	0.048	-0.589**	0.165	0.261*
CP					1.000	-0.409**	0.362**	0.249*	-0.062	-0.506**	0.470**	-0.351**	0.135
PPP						1.000	0.030	0.022	0.272*	0.562**	-0.328**	0.104	0.864**
DM							1.000	0.174	-0.153	-0.297*	0.383**	-0.118	-0.582**
PL								1.000	0.276*	-0.127	-0.335**	-0.094	-0.170
SP									1.000	-0.096	-0.153	0.136	-0.431**
SW										1.000	-0.220	-0.250*	-0.088
SY											1.000	0.202	0.265*
BY												1.000	-0.161
HI													1.000

Table4: Treatment Means24genotypes growthparameterandyieldattribute

Genotype	DFF	PH	PB	SB	CP	PPP	DM	PL	SP	SW	SY	BY	HI
IPM02 – 03	49.333	76.767	2.267	7.000	7.800	15.933	79.667	8.033	7.713	3.617	9.340	48.667	19.247
IPM302 – 2	50.333	84.200	3.433	8.333	8.500	12.433	82.000	7.333	7.713	4.110	10.740	37.667	28.887
ML 1059	48.667	79.200	2.000	6.667	9.700	27.667	81.000	6.867	8.713	3.550	16.840	44.000	37.767
IPM05 - 3 –22	51.00	79.76	2.740	5.667	7.000	14.66	82.33	7.23	5.71	3.600	9.273	48.66	19.11

ISSN PRINT 2319 1775 Online 2320 7876
 UGC CARE Listed (Group -I) Journal Volume 12, Iss 04, 2023

	0	7				7	3	3	3			7	0
Choti Mung -1	52.000	82.033	2.433	6.000	8.567	29.333	82.000	8.267	6.380	3.120	8.607	40.000	21.653
NM- 1 (Dull)	53.333	71.333	3.367	8.333	6.800	13.000	86.000	7.433	6.043	2.577	8.740	48.000	18.300
EC 496839	50.667	70.433	2.367	10.000	7.333	21.767	82.333	7.500	6.713	3.900	10.440	41.000	25.643
China Mung –2	53.000	53.100	3.433	8.000	6.900	14.567	86.000	7.567	5.713	4.047	10.740	45.333	23.813
BDY- R2	50.333	69.400	2.200	8.000	10.933	26.800	81.000	7.633	8.043	3.553	9.770	43.667	22.537
EC 520034	53.000	52.633	2.167	7.667	8.567	12.933	84.667	7.833	8.380	2.987	9.373	42.333	22.347
Bhutan ML–2	52.000	59.800	3.233	8.000	7.700	23.233	83.667	7.667	7.713	3.573	10.740	55.000	19.623
IPM205 – 7	48.000	59.300	1.900	8.000	6.667	14.100	85.000	7.833	6.380	4.077	10.273	44.667	23.207
EC 520014	51.000	67.233	4.067	8.000	8.700	31.533	81.000	7.567	6.713	4.290	9.540	42.667	22.577
HUM–1	49.000	50.900	2.767	8.333	8.233	15.867	80.667	7.300	6.380	3.710	11.373	40.667	28.483
IPM312 - 43K	48.000	69.733	2.700	7.333	7.733	15.400	78.333	7.493	7.713	4.410	10.940	38.667	28.837
KM11 – 584	50.667	89.867	2.500	8.333	9.833	29.667	82.667	7.133	6.713	3.077	11.007	43.333	25.887
ABL - Early	47.667	95.667	2.967	7.667	6.867	13.733	77.667	8.200	5.713	3.607	11.107	41.667	26.907
IPM99 - 01 –10	49.333	83.667	3.400	8.000	8.833	25.100	77.667	7.733	6.380	3.877	10.640	44.000	24.587
Co6	50.667	75.467	3.700	7.667	10.667	15.633	74.667	7.467	6.043	4.337	9.673	42.000	23.263
IPM- 03 – 1	50.000	75.247	3.000	6.333	7.667	16.833	80.667	7.767	8.713	3.680	10.207	43.667	23.417
K – 851	43.333	71.333	3.767	7.667	6.867	15.000	72.333	8.533	7.633	3.833	9.403	43.667	21.683
Virat	44.000	73.000	3.900	8.000	5.870	17.000	67.000	9.400	6.533	4.033	8.750	43.333	20.280
Shikha(extra early)	51.333	77.333	3.953	8.000	5.600	15.000	76.000	9.170	6.973	3.580	10.567	38.000	27.670
Samrat(check Veriety)	50.000	63.500	2.967	6.667	9.967	26.533	82.000	7.500	7.043	3.477	10.573	41.000	25.867
Mean	49.86	72.12	2.968	7.653	8.054	19.32	80.26	7.76	6.99	3.693	10.36	43.40	24.23

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Min.	43.333	50.999	1.900	5.667	5.600	12.433	67.000	6.533	2.577	8.607	8.750	37.667	18.300
Max.	53.333	95.667	4.067	10.000	10.933	31.533	86.000	9.400	4.410	16.840	11.107	55.000	37.767
C.D.	2.770	6.392	0.499	2.531	0.633	1.662	3.919	0.861	1.035	0.371	2.127	8.093	5.835
S.E.(m)	0.970	2.238	0.175	0.841	0.222	0.582	1.372	0.301	0.363	0.130	0.745	2.834	2.043
SE(D)	1.372	3.165	0.247	1.189	0.314	0.823	1.941	0.426	0.513	0.184	1.053	4.008	2.890
C.V.	3.369	5.375	10.198	19.030	4.767	5.215	2.961	6.720	8.983	6.095	12.451	11.309	14.604