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RESEARCH ARTICLE

STUDIES ON THE SCOPE OF GENETIC IMPROVEMENT FOR YIELD AND YIELD RELATED TRAITS IN POTATO (*Solanum tuberosum* L) PRODUCTION

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ABSTRACT

The present experiment was conducted in the winter season during 2009-2010 and 2010-2011 at Seed Production Farm Adisaptagram, Govt of West Bengal, Hooghly, West Bengal with twenty three potato genotypes collected from AICRP on potato, BCKV centre. Twenty three potato genotypes were screened and evaluated for yield and yield related characters *viz*., yield per square meter (kg), yield per plant (kg), number of tubers per plant, number of tubers per square meter, single tuber, weight. (gm), plant height (cm), number of leaves per plant, harvest index, tuber length (mm), tuber breadth (mm), small tuber percentage, medium tuber percentage, large tuber percentage. Analysis of variance for potato clearly revealed significant (at 1% level) differences among the genotypes for all the characters studied. In the present investigation, all the characters showed high heritability coupled with high genetic advance. Tuber yield per plant showed significantly positive correlation both at genotypic and phenotypic level with tuber yield per meter square, single tuber weight (gm) and no. of tubers per plant. Yield per meter square also showed significant positive correlation coefficient with single tuber weight (gm) and no. of tubers per plant. Very high and positive direct effects of no. of tubers per plant, tuber no. per meter square, single tuber weight and yield per meter square were found on tuber yield per plant. From the experimental results, it is evident that the characters *viz*., no. of tubers per plant, single tuber weight, yield per square meter, are important in potato for high tuber and yield per plant and emphasis should be given on these characters in selection of parents for hybridization programme. From the present experiment the genotypes K. Sadabahar and K. Chipsona-1 were identified as the highest performer in respect of yield per plant as well as yield per square meter, but in respect of mean performances K. Chipsona-1 was the best performer for both the characters studied.

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INTRODUCTION

Potato (*Solanum tuberosum* L.) is the world`s third most important food crop after wheat and rice with 325 million tonnes fresh weight production in 2007 (Bradshaw, 2009) of which over half of the production obtained from Asia, Africa, Latin America. Potato popularly known as 'The king of vegetables', has emerged as fourth most important food crop in India after rice, wheat and maize. In world scenario, India became the second largest producer of potato (Scott and Suarez, 2011). India produced 42.34 million ton from 1.86 million ha with an average yield of 22.72 t/ ha of Potato during 2010-11 (Agricultural statistics at a glance, 2012). Though, during the recent past the productivity of potato in India has registered noticeable increase. These increases have primarily been through increases in the area of potatoes planted, but accompanied by some increases in yield per hectare. In contrast, future increases in potato production, which are required to feed an increasing world population, particularly in Asia, Africa and Latin America, will need to come primarily from increases in yield per hectare as new land will not be so readily available. Potato is an energy rich crop producing twice as many calories per hectare as rice or wheat and also acclaimed as highly nutritious for presence of significant concentrations of vitamin-C and the amino acids in its tuber. About 90% of the potato crop in India is grown in the Indo-Gangetic plains and the crop is harvested in February-March. Therefore, fresh potatoes are available only for a few months and the country's requirement for the remaining part of the year has to be met with stored potatoes. The expansion of potato cultivation in the Indo-Gangetic plain has been among the most remarkable developments in the evolution of the crop

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worldwide during the last half century (Bardhan *et al.*, 1999). From a meagre 1.285 million tonnes (t) and 205,000 hectares (ha) in 1949 (Srivastava, 1980), potato production in India now has passed 34 million t (FAO, 2011a) with projections forecasting 50 million t by 2020 (CPRI, 1997). As output continued to expand in recent decades, India has raced up the charts to become the world's second largest potato-producing country. In perspective of these advantages in potato production for various purposes and due to lack of works in potato, done under the Gangetic West Bengal conditions the present study was carried out with the objectives to select good parental lines which may be combined for development of elite lines for breeding procedure to accomplish high yielding varieties and to examine the presence of genetic variation for yield and related parameters of tubers with estimation of heritability and genetic advance for the characters.

MATERIALS AND METHODS

The field experiments were conducted during rabi season at two consecutive years (2009-2010 and 2010-2011) at seed production farm Adisaptagram, Govt of West Bengal situated in district of Hooghly, West Bengal. The area under the experimental site comes under subtropical humid climate and is situated just south of tropic of cancer. Normally mean temperatures range from greater than 10^{o}C in December to less than 40^{o}C during April-May. The sunshine hours during the cropping season varied generally from ten to twelve hours. Annual rainfall varies from 1200-1500mm. the relative humidity remains as high as 95^{o}C or even more during Kharif season and 65-85% during rabi season. The experiment was done in Randomized Block Design with 3 replications with plot size of 2m x 2m with spacing of 25cm x 4cm. Twenty three genotypes were supplied and collected from All India Co-Ordinated Project on Potatoes, Simla through the BCKV centre for the investigation. The twenty three genotypes are K. Jyoti, MS-1/4906, MS-1/1871, MS-1/3708, MS-1/4053, K. Sadabahar, K. Pukhraj, K. Anand, Chipsona-1, Chipsona-2, K. Puskar, K. Khyati, G_4, K_{22}, K. Jawahar, K. Ashoka, K. Chandramukhi, K. Bahar, J-95/22, J-99/48, J-99/243, K. Surya and K. Sutlej

The land was thoroughly ploughed, levelled subsequently and drainage cum irrigation channel was made. Standard fertilizer doses were applied during the land preparation i.e., FYM @ 20-30 tonnes/ha, N @ 120 kg/ha, P_2O_5 @80 kg/ha K_2O @ 150kg/ha. Irrigation was given in three to four different stages. First, after sowing; second, at 21 days after sowing and third, during branching and tuber development stage. First, weeding was done 35 days after sowing and second 45 days after sowing during the growth stages. Spraying of Thiodan @ 1.5ml/lt of water was applied 2 times during tuber initiation stage.

Data were recorded on thirteen different yield and yield attributing characters, *viz*., yield per square meter (kg), tuber yield per plant (kg), number of tubers per plant, number of tubers per square meter, single tuber weight. (g), plant height (cm), number of leaves per plant, harvest index, tuber length,(mm), tuber breadth (mm), small tuber percentage, medium tuber percentage, large tuber percentage. The data were subjected to Analysis of Variance (Singh and Chaudhary, 1985), Genotypic and Phenotypic Co-efficient of Variation (Burton, 1952), Genetic Advance (Johnson *et al.,* 1955 and Lush, 1949), broad sense Heritability (Hanson *et. al.*, 1956), Correlation Co-efficient and Path Co-efficient analysis (Dewey and Lu, 1959).

RESULTS AND DISCUSSION

The analysis of variance (ANOVA) is presented in the Table 1. The results clearly revealed that interaction between genotype and environment were highly significant (at 1% level) for all the characters except harvest index, medium tuber percentage, small tuber percentage, yield per meter square (kg) and total yield per plant (kg). It indicated that environment had little effect on yield per square meter and total yield per plant. It also indicated highly significant differences for all the characters studied, among the genotypes. The findings were in close agreement of previous reports in potato by Khurana *et al.* (2003); Singh *et al.* (2005) and Mishra *et al.* (2005).

Variance, Coefficient of Variation

Estimation of mean, range, coefficient of variation (CV), phenotypic variance (Vp), genotypic variance (Vg), environmental variance (Ve), environmental coefficient of variation (ECV), genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability (broad sense), genetic advance (GA) at 5% selection intensity and genetic advance as percent over mean, of twenty three genotypes are presented in the Table 2.

Moderate to high range of variation was noticed for all the characters which might give scope for selection for further improvement of these traits on the basis of phenotypic values of characters under study. But range was not able to reflect the actual variability present in the population for different characters, because it represents the extreme values only. The relative values for three types of coefficient of variation *viz*., phenotypic, genotypic and environmental, give an idea about the magnitude of genetic variability present in a population. There were narrow differences between corresponding PCV and GCV values for all the characters under study, with slight higher values for the former. Hence, selection based on phenotypic values of these characters would be effective, as environment had little influence in expression of such characters. Mishra *et al.* (2001) also found slightly high PCV values than GCV values, indicated negligible effect of environment on the characters studied in potato. It was also indicated by the lower value of ECV. High GCV and PCV values were recorded for number of tubers per square meter (22.70 and 22.96), single tuber weight (g) (29.22 and 29.36), large tuber percentage (19.02 & 19.90), small tuber percentage (18.19 & 19.99) and tuber yield per plant (kg) (17.70 & 18.48). All the other characters under study showed moderate GCV and PCV values. These indicated that there were moderate to high genetic variability for all the characters under study. Hence, these characters might be improved through selection with greater scope for the former group of characters which have higher GCV and PCV values than the later group of characters which have moderate GCV and PCV values.

Table 1. Analysis Of Variance (ANOVA) for G × E Interaction for Thirteen Different Characters of Potato

Source of Variation	d.f	Mean sum of square												
		P.H	NL	NTP	TN	STW	TL (mm)	TB (mm)	HI	TL (%)	TM (%)	TS (%)	YM (kg)	TYP (kg)
Envt.	1	231.42**	77.15**	2.13	58.79**	239.54**	717.99**	323.46**	3.20	553.12**	412.01**	1037.80**	6.33**	0.33**
Geno.	22	159.33**	53.11**	1.46**	187.78**	1658.44**	190.61**	107.86**	109.53**	143.61**	25.88**	96.83**	0.67**	0.02**
Envt. × Geno.	22	27.76**	9.26**	0.15	6.25**	22.46**	30.29**	4.17**	5.26	26.52**	5.61	5.28	0.14	0.01
Pooled Error	44	3.91	1.30	0.11	1.22	4.58	4.36	1.71	5.95	5.43	6.53	4.75	0.07	0.00

***** Significant at 5% level **Envt**: Environment **Rep**.: Replication **Geno**: Genotype ****** Significant at 1% level
PH: Plant height (cm) **NL**: Number of leaves **NTP**: Number of tuber per plant **TN:** Number of Tubers per meter square
STW: Single Tuber Weight (g) **TL**: Tuber length (mm) **TB**: Tuber breadth (mm) **TL**: Large Tuber Percentage
TM: Medium Tuber Percentage **TS**: Small Tuber Percentage **TYP**: Tuber yield per plant (kg) **YM**: Yield per square meter (kg) **HI:** Harvest Inde

Table 2. Genetic Variability Parameters for Thirteen Different Characters of Potato

Character	Mean	Range		Variance			ECV	GCV	PCV	$h^2_{(BS)}$	GA	GA as % of mean
				Pheno.	Geno.	Envt						
P H	47.82	42.77	54.94	18.96	16.11	2.85	3.53	8.39	9.10	84.95	7.61	15.93
NL	43.52	29.97	52.88	29.97	27.43	2.53	3.66	12.03	12.57	91.50	10.31	23.70
NTP	6.03	4.26	7.66	0.91	0.68	0.23	7.87	13.68	15.79	75.12	1.47	24.44
TN/m^2	43.22	27.63	60.44	98.49	96.29	2.20	3.43	22.7	22.96	97.77	19.98	46.24
STW	98.37	40.26	147.78	834.40	826.64	7.76	2.83	29.22	29.36	99.07	58.94	59.92
TL(mm)	74.05	54.59	100.36	99.87	93.02	6.85	3.53	13.02	13.49	93.14	19.17	25.89
TB(mm)	50.98	37.03	62.81	55.88	53.29	2.59	3.15	14.31	14.66	95.36	14.68	28.80
HI	65.87	53.6	82.96	62.04	51.14	10.90	5.01	10.85	11.95	82.42	13.37	20.30
TL (%)	44.15	29.26	63.63	77.22	70.55	6.67	5.84	19.02	19.90	91.36	16.53	37.45
TM (%)	28.22	22.14	34.66	19.22	7.61	11.61	12.07	9.77	15.53	39.59	3.57	12.66
TS(%)	36.98	29.87	50.21	54.68	45.27	9.40	8.29	18.19	19.99	82.81	12.61	34.10
YM (kg)	3.93	2.79	4.72	0.36	0.34	0.02	3.19	14.89	15.23	95.60	1.17	30.00
TYP(kg)	0.52	0.389	0.753	0.24	0.13	0.11	5.29	17.7	18.48	91.78	0.18	34.94

PH: Plant Height **NL:** Number of Leaves **NTP:** Number of Tubers per Plant **TN:** Number of Tubers per m^2
STW: Single Tuber Weight **TL:** Tuber Length **TB:** Tuber Breadth **TL:** Large Tuber Percentage
TM: Medium Tuber Percentage **TS:** Small Tuber Percentage **TYP:** Tuber Yield per Plant **YM:** Yield per square meter
HI: Harvest Index

Table 3. Genotypic (G) and Phenotypic (P) Correlation Coefficients between Different Characters of Potato on Tuber Yield per Plant

Characters		P.H	NL	NTP	TN	STW	TL(mm)	TB(mm)	HI	TL(%)	TM(%)	TS(%)	YM(kg)	TYP(kg)
P.H	**G**	**1**	0.128	-0.059	0.164	-0.07	-0.041	-0.046	-0.1	-0.127	**0.611****	**-0.376***	-0.097	0.076
	P	**1**	0.094	-0.023	0.141	-0.064	-0.035	-0.052	-0.078	-0.105	0.337	-0.324	-0.082	0.055
	G		**1**	-0.197	0.107	-0.339	0.129	-0.23	0.159	-0.08	-0.131	-0.218	**0.359 ***	0.019
NL	**P**		**1**	-0.154	0.106	-0.326	0.125	-0.207	0.129	-0.065	-0.03	-0.19	0.328	0.011
NTP	**G**			**1**	-0.05	-0.093	-0.001	-0.086	0.067	0.054	0.075	0.113	**0.544***	**0.525****
	P			**1**	-0.049	-0.067	0.014	-0.097	0.017	0.027	0.077	0.076	**0.453 ***	**0.480****
	G				**1**	-0.096	0.192	-0.272	-0.04	-0.112	0.088	-0.06	0.305	0.269
TN	**P**				**1**	-0.094	0.196	-0.261	-0.025	-0.103	0.06	-0.062	0.299	0.259
	G					**1**	**0.547****	**0.754****	-0.116	0.333	-0.158	-0.085	**0.654****	**0.566****
STW	**P**					**1**	**0.533****	**0.732****	-0.108	0.316	-0.09	-0.074	**0.532****	**0.543****
TL(mm)	**G**						**1**	0.234	0.06	0.325	**-0.392***	-0.259	0.266	-0.095
	P						**1**	0.226	0.074	0.303	-0.217	-0.236	0.256	-0.089
	G							**1**	-0.194	0.171	-0.169	0.051	0.08	-0.108
TB(mm)	**P**							**1**	-0.162	0.161	-0.076	0.047	0.071	-0.109
	G								**1**	0.066	-0.206	-0.307	-0.158	-0.238
HI	**P**								**1**	0.015	-0.106	-0.275	-0.127	-0.225
	G									**1**	**-0.567****	**-0.458***	0.081	-0.069
TL(%)	**P**									**1**	**-0.352***	**-0.376***	0.081	-0.064
	G										**1**	0.112	-0.34	-0.045
TM(%)	**P**										**1**	0.091	-0.195	-0.012
	G											**1**	0.038	0.118
TS(%)	**P**											**1**	0.033	0.09
YM(kg)	**G**												**1**	**0.696****
	P												**1**	**0.678****
TYP(kg)	**G**													**1**
	P													**1**

* Significant at 5% level ** Significant at 1% level **Envt**: Environment **Rep**.: Replication **Geno**: Genotype **PH**: Plant height (cm) **NL**: Number of leaves **NTP**: Number of tuber per plant **TN:** Tuber number per square meter **STW**: Single Tuber Weight (gm) **TL**: Tuber length (mm) **TB**: Tuber breadth (mm) **TL**: Tuber large (%) **TM**: Tuber medium (%) **TS**: Tuber small (%) **TYP**: Tuber yield per plant (kg) **YM**: Yield per square meter

Table 4. Direct (Diagonal Bold) and Indirect Effects between Different Characters of Potato on Tuber Yield per Plant

Characters	P.H	NL	NTP	TN	STW	TL (mm)	TB (mm)	HI	TL (%)	TM (%)	TS (%)	YM (kg)
P H	**0.398**	-0.018	-0.025	0.020	-0.015	0.016	0.011	0.023	0.038	-0.337	0.014	0.048
NL	0.051	**-0.141**	-0.085	0.013	-0.071	-0.050	0.056	-0.036	0.024	0.072	0.008	0.179
NTP	-0.024	0.028	**0.799**	-0.006	-0.020	0.000	0.021	-0.015	-0.016	-0.042	-0.004	0.172
TN	0.065	-0.015	-0.022	**0.722**	-0.020	-0.075	0.066	0.009	0.033	-0.049	0.002	0.152
STW	-0.028	0.048	-0.040	-0.012	**0.811**	-0.213	-0.184	0.026	-0.099	0.087	0.003	0.063
TL(mm)	-0.016	-0.018	0.000	0.023	0.115	**-0.079**	-0.057	-0.014	-0.097	0.217	0.010	0.133
TB(mm)	-0.018	0.033	-0.037	-0.033	0.159	-0.091	**-0.244**	0.044	-0.051	0.093	-0.002	0.040
HI	-0.040	-0.022	0.029	-0.005	-0.025	-0.023	0.047	**-0.226**	-0.020	0.114	0.012	-0.079
TL (%)	-0.051	0.011	0.023	-0.014	0.070	-0.127	-0.042	-0.015	**-0.197**	0.314	0.017	0.041
TM (%)	0.243	0.019	0.033	0.011	-0.033	0.153	0.041	0.047	0.168	**-0.093**	-0.004	-0.169
TS(%)	-0.150	0.031	0.049	-0.007	-0.018	0.101	-0.013	0.069	0.136	-0.062	**-0.038**	0.019
YM(kg)	-0.038	-0.051	0.148	0.037	0.027	-0.104	-0.019	0.036	-0.024	0.188	-0.001	**0.799**

Residual Effect= 0. 0.2045 **P.H**: Plant height (cm) **NL**: Number of leaves **NTP**: Number of tuber per plant **TN**: Tuber number **ST W**: Single tuber weight (gm) **TL**: Tuber length (mm) **TB**: Tuber breadth (mm) **HI**: Harvest index **TLR**: Large Tuber (%) **TM**: Medium Tuber (%) **TS**: Small Tuber (%) **YM**: Yield per square meter (kg) **TYP**: Tuber Yield per Plant (kg) **HI:** Harvest Index

Heritability and Genetic Advance

In the present investigation, heritability was high for all the characters under study, indicating that these characters were less influenced by the environmental effects. The heritability estimates were high for single tuber weight (g) (99.07), number of tubers per square meter (97.77), yield per square meter (kg) (95.60) and yield per plant (kg) (91.78). Hence selection would be effective for improvement of these characters. Improvement in the mean genotypic value of best selected plants over the parental population is known as genetic advance. It is the measure of genetic gain under selection. The success of genetic advance under selection depends on three main factors namely, genetic variability, heritability and selection intensity (Alllard, 1960). Genetic advance as percent over mean is better indicator of genetic gain under selection than genetic advance. In the present experiment all the characters under study showed high genetic advance (as percent over mean). Heritability and genetic advance are important selection parameters. Heritability estimates along with genetic advance are more helpful in predicting the genetic gain under selection, than heritability estimates alone (Johnson *et al*, 1955). High heritability coupled with high genetic advance indicates the importance of additive gene effects in controlling such character (Panse, 1957). He also reported that low heritability accompanied with genetic advance is due to non-additive gene effects for the particular character and would offer less scope for selection because of the influence of environment. In the present investigation high heritability coupled with high genetic advance was noted in single tuber weight (g) and number of tubers per square meter. This indicated that most likely the heritability is due to additive gene effect or additive gene action is predominant for controlling all the characters under study. Therefore, selection may be rewarded in improvement of these characters. Comparatively low heritability with low genetic advance was noted in medium tuber percentage which suggested non-additive gene action and complex breeding methods may be suggested for improvement of the traits. Genetic advance was found to be moderately high for tuber length (mm), tuber breadth (mm) and large tuber percentage and these characters are influenced by additive and non-additive gene action. Regarding genetic advance as percent mean, all the characters studied showed moderate to high effects. Sattar *et al*. (2007) also reported high heritability coupled with high genetic advance as percent of mean and high genotypic coefficients were observed for number of tubers per plant, yield per plant and average weight of tuber.

Correlation

Phenotypic and genotypic correlations were computed for all possible paired combinations among the twelve different characters including yield. The phenotypic and genotypic correlation coefficients between different characters under study are presented in Table 3. In the present study, generally genotypic correlation coefficients (r_g) were higher than the corresponding phenotypic correlation coefficients (r_p) indicating the true genetic association between the characters and the differences between these two types of correlations were also small. Similar results were also recorded earlier by Giovani *et al.* (2006). In the following discussion on correlation between different characters; the main emphasis is given on the genotypic correlations. Tuber yield per plant (kg) showed significantly positive correlation both at genotypic and phenotypic level respectively with tuber yield per meter square (kg) (0.696^{**} & 0.678^{**}), single tuber weight (g) (0.566^{**} & 0.543^{**}), number of tubers per plant (0.525^{**} & 0.480^{**}). Yield per meter square (kg) also showed significant positive correlation with single tuber weight (g) (0.654^{**} & 0.532^{**}) and number of tubers per plant (0.544^{*} & 0.453^{*}). The medium tuber percentage and small tuber percentage had negative significant correlation with tuber length (-0.567^{**}, -0.352^{*} & -0.458^{*}, -0.376^{*}). Ghasem Rahimi Darabad (2014) also found the similar type of result in potato. It was observed that single tuber weight (g) was significantly and positively correlated with tuber length (mm) and tuber breadth (mm).

At genetic level a positive correlation occurs due to coupling phase of linkage and negative correlation arises due to repulsion phase of linkage of genes controlling two different traits. Both types of correlation may arise from pleiotropy and developmental or allometric relationship. However, a transient genetic correlation may be due to linkage disequilibrium rather than pleiotropy. No correlation indicates that genes concerned are located far apart on the same chromosome or they are located in different chromosomes. The nature of correlation can often be altered by selection and hybridization. In the present study it is not possible to draw valid conclusion about pleiotropy and linkage, because separation of these factors requires investigations of variance and covariance among individuals within generations over a number of different generations.

From the above discussion on correlation coefficient in potato, it is evident that the characters *viz*., tuber yield per meter square (kg), single tuber weight (g), number of tubers per plant are the important characters in determining tuber yield per plant (kg). The complex natures of relationship among characters and with tuber yield per plant (kg) become evident from the above discussion. Such estimates of correlations alone do not provide a comprehensive picture of the relative importance of the direct and indirect influences of each character to the fruit yield per plant. As correlation coefficients are insufficient to explain the relationship between characters for an efficient manipulation of characters, path coefficient analysis was done.

Path analysis

Knowledge of correlation alone is often misleading because two characters may show correlation just because they are correlated with a common third one. In such cases, it becomes necessary to study a method, which takes into account the causal relationship between the characters in addition to the degree of relationship. In the present investigations tuber yield per plant was taken as a dependent or resultant variable and all the others characters, under study as independent or causal variables. The genotypic path analysis is presented in Table 4. Very high and positive direct effects of number of tubers per plant (0.799), number of tubers per meter square (kg) (0.722), single tuber weight (g) (0.811) and yield per meter square (kg)

(0.799) were found on tuber yield per plant (kg). Besides these, other characters studied had negligible to moderate direct effect on tuber yield per plant (kg) in general. Yield per meter square (kg) had negligible to low positive and negative indirect effect on yield per plant (kg). Plant height had high positive direct effect and moderate positive indirect effect on tuber yield via medium tuber percentage. Small tuber percentage (-0.038) had very low negative direct effect on tuber yield per plant (kg). In the present study on path coefficient analysis, the residual effect (0.2045) was low, indicating the adequacy and appropriateness of the characters chosen for this experiment. It was also revealed that twelve characters, chosen in the experiment, adequately explained the variation at genotypic level for tuber yield per plant (kg) in path analysis study. A valid conclusion from correlation and path analysis can only be drawn when we consider their results jointly. The above discussion on correlation coefficient and path coefficient analysis in potato revealed that number of tubers per plant, single tuber weight (g) and yield per square meter (kg) are important characters in controlling tuber yield per plant (kg). The information obtained from the association studies helps in indirect selection for genetic improvement of tuber yield per plant (kg). Greater yield response is obtained when the characters for which the indirect selection is practiced has a high heritability. In the present investigation, most of the characters under study had high heritability.

From the experimental results, it is evident that the characters *viz*., number of tubers per plant, single tuber weight (g) and yield per square meter (kg) are important characters in potato for high tuber yield per plant (kg) and emphasis should be given on these characters in selection of parents for hybridization programme. These characters can also be considered as effective indirect selection criterion in selection for high tuber yield per plant (kg) in potato.

Conclusion

From the association studies, the characters, *viz*., plant height (cm), number of tubers per plant, number of tubers per square meter, single tuber weight (g) was established as the most important yield contributing characters of potato. Hence, these characters might be considered as effective selection criteria for indirect selection of high tuber yield per plant (kg). From the above discussion on correlation coefficient in potato, it is evident that the characters *viz*., tuber yield per meter square (kg), single tuber weight (g), number of tubers per plant are the important characters in determining tuber yield per plant (kg) and at the similar time those characters were found to have very high and positive direct effects on tuber yield per plant (kg). Besides these, other characters studied had negligible to moderate direct effect on tuber yield per plant in general. From the experimental results, it is evident that the characters *viz*., number of tubers per plant, single tuber weight (g), yield per square meter (kg) are important characters in potato for high tuber yield per plant (kg) and emphasis should be given on these characters in selection of parents for hybridization programme. These characters can also be considered as effective indirect selection criterion in selection for high tuber yield per plant (kg) in potato.

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