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Correlation studies in potato (*Solanum tuberosum* L.) under varied fertility regimes and planting seasons in mid hills of Himachal Pradesh

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Abstract

Field study was conducted on the interrelationship amongst tuber yield and different horticultural and quality traits in four cultivars (Kufri Jyoti, Kufri Giriraj, Kufri Chipsona-1 and Kufri Chipsona-2) of potato evaluated during spring (2001 and 2002) and autumn (2001-02 and 2002-03) seasons at 3 levels of organic manure (0, 100% recommended dose of FYM *i.e.* 30 t FYM/ha and 50% more than recommended *i.e.* 45 t FYM/ha) and 5 levels of inorganic fertilizers *viz.*, control, 75% recommended dose of NPK, 100% recommended NPK, 125% recommended dose of NPK and 150% recommended dose of NPK. The recommended dose of NPK was 120:100:100 kg N, P_2O_5 and K_2O/ha, respectively. Tuber yield/ha was positively associated with average tuber weight (0.8025), tuber yield per plant (0.5352), N uptake (0.7423), P uptake (0.8273), K uptake (0.6832), number of stolon (0.8151), plant height (0.6565), dry matter yield (0.8502) and reducing sugars (0.4809) and negative correlation with specific gravity (-0.4212) and dry matter content (-0.3843).

Key words: Potato, *Solanum tuberosum*, correlation, fertility regimes, planting seasons, cultivars

Introduction

Potato (*Solanum tuberosum* L.) is an important crop in the world and ranks fourth after rice, wheat and maize. Potato can play a major role in eradicating hunger and malnutrition-an important millennium development of United Nation. Potato play vital role in global food system as it produces more food and edible protein per unit area and time and contribute to energy and nutritional needs of more than one billion people. Keeping in view the importance of the crop, the United Nation has declared the year 2008 as the international year of potato. Yield is a complex character, which is dependent upon several of its components and also influenced by environmental factors, therefore, direct selection for high yield is often misleading. The correlation studies between yield and other agronomic traits had been of immense help in selection of suitable plant type. Aknowledge of inter-relationship, if any, that may exist between different characters provides the explanation for the type of effect produced. Though a lot of work had been done on interrelationships among various traits in potato, however, a limited work has been done on interrelationships of traits concluded simultaneously over different varieties and growing seasons at different fertility levels.

Material and Methods

A field study was carried out for four consecutive seasons during spring (2001 and 2002) and autumn (2001-01 & 2001-03) at the Vegetable Farm (30°-51' N latitude and 77°-11' E longitude and 1260 m altitude), Department of Vegetable Crops, Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan, representing mid hill zone of Himachal Pradesh. The experiment comprising of 60 treatments, was laid out in factorial RBD with three replications in plots of 2×2 m^2. The treatments comprised of all possible combinations of four varieties *viz.*, Kufri Jyoti (V_1), Kufri Giriraj (V_2), Kufri Chipsona-1 (V_3) and Kufri Chipsona-2 (V_4) with 3 levels of organic manure *viz.*, no FYM (F_1), 100 % recommended FYM i.e. 30t /ha (F_2) and 50 % more than recommended *i.e.* 45 t/ha (F_3) and 5 levels of inorganic fertilizer *viz.*, no NPK (N_0), 25 % less NPK than recommended (N_1), 100% recommended NPK (N_2), 25 % more than recommended (N_3) and 50 % more than recommended (N_4). The recommended dose of NPK was 120:100:100 kg/ha, respectively. The inorganic fertilizers were applied in the form calcium ammonium nitrate (25% N), single super phosphate (16% P_2O_5) and muriate of potash (60% K_2O). A day before the scheduled date of planting, the large seed tubers were cut into pieces (25–30g

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per piece) treated with 0.25 % solution of Dithane M-45 for ten minutes against the tuber born fungal diseases. They were then dried in shade for 16 hours and then planted in field 5 cm deep and 20 cm apart in ridges. Ridge to ridge distance was kept 60 cm. For autumn crop, plantings were done on 27th October, 2001 and 28th October, 2002, while for spring crop, plantings dates were 26th April, 2002 and 28th April, 2003. Irrigation was applied by surface channel. The different varieties of potato were harvested when haulms started drying. Correlation studies were carried out among 16 characters *viz.*, days to germination, plant height (cm), maturity period (days), number of stolons per plant, number of haulms per plant, reducing sugars (%), specific gravity (%), number of tubers per plant, dry matter yield (kg/ha), tuber yield (q/ha), average tuber weight (g), dry matter content (%), tuber yield/plant (g), N uptake (kg/ha), P uptake (kg/ha) and K uptake(kg/ha).

Results and Discussion

Correlation coefficient based on pooled data of four seasons *i.e.* autumn (2001 & 2002) and spring (2001-02 & 2002-03) between yield and different traits are given in Table 1. It was found that days to germination exhibited positive and significant correlation with maturity period (0.4512) and tuber yield/plant (0.2529), but was negatively and significantly correlated with number of haulms per plant (-0.2292), specific gravity (-0.2336), number of tubers per plant (-0.2342), dry matter content yield ha^{-1} (-0.2229), average tuber weight (-0.1968), N uptake (-0.3474), P uptake (-0.2691) and K uptake (-0.3177).

Plant height had positive and significant relationship with number of stolons per plant (0.9071), reducing sugar (0.5523), number of tubers per plant (0.7206), dry matter yield/ha (0.4202), tuber yield/ha (0.6565), average tuber weight (0.5801), tuber yield per plant (0.7398), N uptake (0.4559), P uptake (0.4524) and K uptake (0.3561). However, the association was found negative and significant with specific gravity (-0.4235) and per cent dry matter content (-0.5014). These results are in agreement with the findings of Singh and Jain (1968); Singh (1971) and Patel *et al.* (2002), who also reported that plant height was positively and significantly associated with tuber yield.

Maturity period had positive and significant association with reducing sugar (0.7638), tuber yield/ha (0.2525) and tuber yield/plant (0.2002). However, it had significant but negative relationship with average tuber weight (-0.1557), number of haulms/plant (-0.3796), specific gravity (-0.8520), per cent dry matter content (-0.7889), N uptake (-0.3846), P uptake (-0.2331) and K uptake (-0.3999).

Number of stolons had positive and significant association with reducing sugar (0.5002), number of tubers per plant (0.7690), dry matter content yield ha^{-1} (0.6358), tuber yield/ha (0.8151), average tuber weight (0.6814), tuber yield per plant (0.7872), N uptake (0.6385), P uptake (0.6577) and K uptake (0.5576), whereas it was associated significantly and negatively with specific gravity (-0.3906) and per cent dry matter content (-0.4235).

Number of haulms per plant had positive and significant association with specific gravity (0.5547) and per cent dry matter content (0.4882). It was negatively and significantly associated with reducing sugar (-0.6145) and average tuber weight (0.3135). Similar were the results of Patel *et al.* (2002).

Reducing sugar was associated significantly and positively with number of tuber per plant (0.3075), tuber yield/ha (0.4809), average tuber weight (0.4657) and tuber yield per plant (0.3183), whereas it was negatively but significantly correlated with specific gravity (-0.9650), per cent dry matter content (-0.9769) and K uptake (-0.2197).

Positive and significant association of specific gravity was found with per cent dry matter content (0.9599), N uptake (0.2426) and K uptake (0.2978), while negative and significant association was found with number of tubers/plant (-0.2083), tuber yield/ha (-0.4212), average tuber weight (-0.3940) and tuber yield/plant (-0.2406). Number of tuber per plant was positively associated with dry matter yield/ha (0.6683), tuber yield/ha (0.7470), average tuber weight (0.7096), tuber yield per plant (0.5486), N uptake (0.6305), P uptake (0.6591) and K uptake (0.5762), whereas it was significantly and negatively correlated with per cent dry matter content (-0.2020) only. Frederiksen (1957) and Borah and Mithorpe (1962) have also emphasized the role of tuber number in increasing yield.

Dry matter yield/ha was positively associated with tuber yield/ha (0.8502), average tuber weight (0.6563), tuber yield per plant (0.4335), N uptake (0.9505), P uptake (0.9899) and K uptake (0.9366). Tuber yield/ha was positively

Table 1. Correlation coefficient (r) among various growth, quality and yield contributing characters

Traits	Days to germination	Plant height (cm)	Maturity period (days)	Number. of stolons /plant	Number of haulms /plant	Reducing sugars (%)	Specific gravity (%)	Number of tubers /plant	Dry matter yield (kg/ha)	Tuber yield (q/ha)	Average tuber weight (g)	Dry matter content (%)	Tuber yield/ plant (g)	N uptake (kg/ha)	P uptake (kg/ha)	K uptake (kg/ha)
Days to germination	1.0000															
Plant height (cm)	-0.1146	1.0000														
Maturity period (days)	0.4512**	0.1509	1.0000													
Number of stolons/plant	-0.0972	0.9071**	0.1795	1.0000												
Number of haulms/plant	-0.2292*	-0.1349	-0.3796**	-0.1355	1.0000											
Reducing sugars(%)	0.1606	0.5523**	0.7638**	0.5002**	-0.6145**	1.0000										
Specific Gravity (%)	-0.2336*	-0.4235**	-0.8520**	-0.3906**	0.5547**	-0.9650**	1.0000									
Number of tubers/plant	-0.2342*	0.7206**	-0.0036	0.7690**	-0.1405	0.3075**	-0.2083*	1.0000								
Dry matter yield (kg/ha)	-0.2299*	0.4202**	-0.1799	0.6358**	0.0901	-0.0373	0.0933	0.6683**	1.0000							
Tuber yield (q/ ha)	-0.1119	0.6565**	0.2525**	0.8151**	-0.1857	0.4809**	-0.4212**	0.7470**	0.8502**	1.0000						
Average tuber weight (g)	-0.1968*	0.5801**	0.1557	0.6814**	-0.3133**	0.4657**	-0.3940**	0.7096**	0.6563**	0.8025**	1.0000					
Dry matter content (%)	-0.1904	-0.5014**	-0.7889**	-0.4235**	0.4882**	-0.9769**	0.9599**	-0.2020*	0.1523	-0.3843**	-0.3499**	1.0000				
Tuber yield/ plant (g)	0.2529**	0.7398**	0.2002*	0.7872**	-0.1729	0.3183**	-0.2406*	0.5486**	0.4335**	0.5352**	0.4044**	-0.2387*	1.0000			
N uptake (kg/ha)	-0.3474**	0.4559**	-0.3846**	0.6385**	0.1796	-0.1564	0.2426*	0.6305**	0.9505**	0.7423**	0.5545**	0.2647**	0.4295**	1.0000		
P uptake (kg/ha)	-0.2691**	0.4524**	-0.2331*	0.6577**	0.0997	-0.0564	0.1243	0.6591**	0.9899**	0.8273**	0.6388**	0.1746	0.4552**	0.9770**	1.0000	
K uptake (kg/ha)	-0.3177**	0.3561**	-0.3999**	0.5576**	0.1142	-0.2197*	0.2978**	0.5762**	0.9366**	0.6832**	0.5492**	0.3491**	0.4034**	0.9595**	0.9586**	1.0000

* Significant at 1% level of significance
** Significant at 5% level of significance

associated with average tuber weight (0.8025), tube yield per plant (0.5352), N uptake (0.7423), P uptake (0.8273) and K uptake (0.6832), while it was significantly and negatively associated only with per cent dry matter content (-0.3843). Singh and Jain (1968) also reported that weight of tuber per plant was positively correlated with yield (ha^{-1}). The increase in tuber weight resulting in increase in yield (ha^{-1}) has also been documented by different workers (Dhruv *et al.* 2001 and Malik *et al.* 2002).

Average tuber weight was positively correlated with tuber yield/plant (0.4044), N uptake (0.5545), P uptake (0.6388) and K uptake (0.5492), however, it was negatively and significantly associated with per cent dry matter content (-0.3499). The present results are in line with the findings of Singh and Jain (1968).

Dry matter content was positively associated with N uptake (0.2647) and K uptake (0.3491), while it was negatively and significantly associated with tuber yield per plant (-0.2387). Gaur (1977) also reported negative correlation (r = -0.29) for tuber yield and per cent dry matter.

Tuber yield per plant was associated positively with N uptake (0.4295), P uptake (0.4552) and K uptake (0.4034). N uptake was associated positively and significantly with K uptake (0.9770) and P uptake (0.9595) whereas K uptake was positively associated with P uptake (0.9586). Based on the data obtained in the present investigation, it was observed that tuber weight, number of tubers per plant, NPK uptake, number of stolon, plant height and dry matter yield are the important traits, which had significant and positive contribution towards higher tuber yield. However the quality of tubers impaired with the increase in tuber yield/ha as showed by positive and significant correlation with reducing sugars and negative and significant correlation with specific gravity and dry matter content (%).

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