

***Research Paper***

**THE EFFECT OF CORRELATION AND PATH COEFFICIENT ANALYSIS ON  
YIELD AND SIX VEGETATIVE PARAMETERS IN IRISH POTATO  
(*Solanum tuberosum*)**

Yerima, I.

Department of Biological Sciences, Faculty of Science,  
University of Maiduguri, Nigeria.

**Abstract**

This experiment was carried out in the experimental garden of the Department of Botany University of Jos, Nigeria, during the rainy season of 1985. Dormant and healthy potato tubers of the variety B6934-11 obtained from the National Root Crop Research Institute Vom, Nigeria were stored at a temperature of 40f 22.2c to sprout. The well sprouted tubers were planted in a randomized complete block design with two replications, each represented by two ridges of 120cm by 600cm. Above and underground parameters were measured 12 and 13 weeks after planting respectively. Correlation and path coefficient analysis showed a significant and positive correlations between yield and number of compound leaves ( 0.336 ), terminal leaflet area (0.487 ) and length of primary stolon( 0.606). The three parameters with greater association with yield i.e. number of compound leaves ,terminal leaflet area and length of primary stolon among the three , length of primary stolon exerted the maximal direct positive effect on yield. The path way to yield as caused by length of primary stolon was negligibly influenced by indirect effect via other parametres.

Key words: rainy season, correlation, path analysis, irish potato, tuber yield, Plateau.

**INTRODUCTION**

Irish potato (*Solanum tuberosum* L.) originated in the Andes highland in southern America. It has been proposed that two wild diploid (2n) species intercrossed naturally to produce a tetraploid (4n) cultivated type. Maine and Simpson (1999) using callus culture or colchicine treatment indicated that plants with double chromosome number (polyploid) produce more shoots than monoploid (n). The intercrossed tetraploid (4n) species were collected and selected to evolve the current typical cultivated species, which has been under cultivation well before 400 B.C. The planting stock of potato was obtained from Ireland by Scottish Irish immigrants, hence the name Irish potato (Kehr 1964, Stevenson 1951). Potato is a cool weather plant that grows better where the mean July temperature is about 70°F (38.9°C) or lower.

The world production of potato is nearly 300 million metric tonnes annually. Except for cereals, it is the world most important food crops. They are grown on more than 22 million hectares with a yield of 13.3 metric tonnes per hectare. In the United States potatoes were harvested on an average of 1,357,000 acres (0.55 million hectares) from 1970 to 1972 with a production of more than 3.3 million hundredth weight (142.2 million metric tonnes) and a yield

of 231 or 25.9 metric tones per hectare. In Kenya Irish Potato is an important food crop, the crop is second to maize (Muthon 2009). In Nigeria potato is grown at subsistence level and below the country's requirement. The countries leading in potato production are the Soviet Union, Poland, Western Germany, the United States, East Germany, France and China. In the United States nearly 8% of the potato is used for planting, and about 10% fed to livestock or lost by shrinkage and decay, chiefly the later. The yearly consumption per capita was about 198 pound ( ) in 1910 and declined to 103 pounds in 1952 but increased to 119 pound in 1971 when half of potato were processed in forms such as frozen French fried chips, shoestring and dehydrated, plus some canned alone or in mixture (Sullivan 1970). Dehydrated potatoes also are used in whisky manufacture, some 8 to 12 million pounds are proposed in starch and flour. In Germany many potatoes are processed into starch and alcohol, or fed to livestock, Russian vodka is made from potato.

The average whole potato consist of about 79% water, with only 2% protein, 0.1% fat, 0.6% crude fiber and 17% to 18% nitrogen free extract. About 20% of a large some of tuber consists of peels i.e. perineum (or skin) plus some of the layer of the cortex (Caldwell 1944). The remainder consists of about 78% starch, sugar and other carbohydrate. The dry mater consists of about 70% starch, 15% other carbohydrates 10% protein, 4.41% ash and 0.3% fat. High starch content, high amount of solids and specific gravity associated with meatiness and good cooking quality for chips, baking boiling, mashing or French frying. The potato solids and starch content can be measured by determination of the specific gravity of the whole tuber. The mealiest baking potatoes have specific gravity of 1.8 or higher which indicate solid content above 20% as well as a starch content of about 15%. Those potatoes most suitable for boiling, marketing or French frying have specific gravities of 1.080 or higher, with at least 19.8% solids and 14% starch. Growth of vegetative characters are simultaneous and correlated with yield. Where growth hormones are sufficiently supported by adequate nitrogen, leaves become broader and elongated, this results in an increase in photosynthetic areas which subsequently heightens the plant. Roy and Sharma (1999) observed that when NPK rate was raised from 50-150% of the recommended 180kg/ha there was an increase in the number and yield of large sized tubers. The above discussion indicate a correlation between height and yield as observed by (Desia and Jaimini 1999), where phenotypic correlation and path analysis showed that tuber yield, days to maturity and plant height had significant positive correlation with all other characters except protein and sugar content). Growth of vegetative characters are simultaneous and correlated with yield, as part of effort to monitor the yield and performance of potato and its interrelationship with other morphological. (phenotypic) characters, Majid et al (2011) observed that tuber yield is a complex character associated with describes simple relationship. Many interrelated components, generally path coefficient is needed to clarify relationship between characters because correlation coefficients morphological observations were carried out on potato planted at four replication in randomized complete block design, designed to estimate the degree of association between yield and other vegetative characters with a view to selecting high yielding varieties, especially for the uplands of Nigeria when rainfall and temperature is adequate, but potato is grown at subsistence level and below the country's requirement.

## 2.0 Materials and Method

This experiment was carried out in the experimental garden of Department of Botany University of Jos, Nigeria. Jos is located on a plateau situated at latitude 10° and 9°4' North and longitude 8° 2' and 9°00' East with an altitude of 1600m above sea level. Dormant and healthy potato tubers of the variety B6934-11 obtained from the National Root Crop Research Institute Vom were stored at a temperature ranging from 40°F (22.2°C) to 60°F (33.3°C) maintained constant by a room blow heater, and disilluminated to prevent greening and photosynthesis. Tubers sprout at between 60 and 90 days at 20°C in light and darkeness respectively (Fontes and Finger 1999). At this temperature the tuber are ready for planting. Sprouting of tubers in storage occurs at temperature of 40°F (22.2°C) or higher but only after completion of rest period which is caused by restricted oxidation (Appleman 1914). The rest period may range from four

to sixteen weeks when the potatoes are stored at 70°F (38.9°C) or longer at lower storage temperatures. Immature tubers may have a longer rest period. Storage temperature of 4-5°C delays sprouting for up to 10 months (Fontes and Finger 1999).

Generally high temperature and low radiation limits potato production. Zemba (2013) was of the view that maximum and minimum temperature correlates with Irish potato at 1% and with yield at 5%. Production could be between 40 to 700 kg of tuber/ha. The dormant potato tubers were kept for sixteen weeks from October 1984 to January 1985 to cover the required period of sprouting. More than sixteen weeks at optimal temperature the sprouts deteriorate and this affects growth and development of tubers. Randal (1993) indicated that planting of potato early or late can lead to disease, reduced vigour and low canopy and tuber bulkiness respectively. Pre-planting weights were recorded for 112 well sprouted tubers. The well sprouted tubers were planted during the dry season in a randomised complete block design with two replication, each represented by two ridges of 120 cm by 600 cm. The tubers were planted 40 cm apart and 40 cm in rows with the smallest tuber on replica block one as plant one and the heaviest tuber on replica block four as plant 112. Each replicate block contains 28 tubers. The average emergence date of tubers was 19<sup>th</sup> January 1985. The field was irrigated twice a day and weeded when necessary.

Measurement of above ground parameters, namely number of stem, number of compound leaves, terminal leaflet area and stem height/planting commenced on the 19<sup>th</sup> of April 1985 (12 weeks after planting). Underground parameters, length of primary stolon, number of primary stolon and weight of tubers were recorded at harvest (13 weeks after planting). A total of seven parameters for 92 of 112 plants were recorded for the purpose of analysis.

### 2.1 Statistical Analysis

The data collected was analysed by simple and partial correlation at 5% and 1% levels of significance parameters with high level of correlation and significance with yield were probed by path coefficient analysis as suggested by (Wright 1959).

## 3.0 Result and Discussion

### 3.1 Effect of correlation on yield and vegetative parameters

The degree of association between yield (i.e. weight of tubers harvested per plants) and several vegetative parameters in potato cv. B6934-11 was assessed by correlation analysis. Table 1 shows the coefficient of correlation (r) and the

- 1 = Number of stem/plant
- 2 = Number of compound leaves
- 3 = Terminal leaflet area/plant
- 4 = Length of primary stolon/plant
- 5 = Number of primary stolon/plant
- 6 = Stem height/plant
- 7 = Weight of tubers/plant

Table 1: Table showing the result of correlation between yield and the six vegetative parameters and all interactions

GROUP ONE			GROUP TWO			GROUP THREE		
Correlated characteristics	Correlation coefficient r	Coefficient of determination $r^2$	Correlated characteristics	Correlation coefficient r	Coefficient of determination $r^2$	Correlated characteristics	Correlation coefficient r	Coefficient of determination $r^2$
1.7	-0.19 n.s	0.032	2.7	0.336**	0.149	3.7	0.487**	0.237
17.2	-0.251*	0.067	27.1	0.419**	0.176	37.1	0.496**	0.246

17.23	-0.293**	0.085	27.13	0.56**	0.276	37.12	0.54**	0.299
17.24	-0.213*	0.045	27.14	0.671**	0.450	37.14	0.616**	0.379
17.25	-0.361**	0.130	27.15	0.465**	0.931	37.15	0.565**	0.319
17.26	-0.244	0.059	27.16	0.569**	0.323	37.16	0.511**	0.261
17.3	-0.203nis	0.041	27.3	0.441**	0.159	37.2	0.528**	0.279
17.32	-0.294**	0.086	27.31	0.529**	0.279	37.21	0.546**	0.278
17.34	-0.035nis	0.001	27.34	0.904**	0.817	37.24	0.877**	0.769
17.35	-0.376**	0.141	27.35	0.414**	0.171	37.25	0.524**	0.275
17.36	-0.138nis	0.019	27.36	0.263**	0.069	37.26	0.529**	0.279
17.4	0.026nis	0.001	27.4	0.714**	0.509	37.4	0.616**	0.379
17.42	-0.211**	0.044	27.41	0.678**	0.459	37.41	0.624**	0.389
17.43	-0.037nis	0.001	27.43	0.907**	0.823	37.42	0.870**	0.756
17.45	-0.350**	0.122	27.45	0.997**	0.994	37.45	0.566**	0.320
17.46	-0.122nis	0.014	27.46	0.684**	0.468	37.46	0.648**	0.319
17.5	-0.390**	0.152	27.5	0.323**	0.104	37.5	0.465**	0.216
17.52	-0.370**	0.136	27.51	0.962**	0.925	37.51	0.561**	0.314
17.53	-0.376**	0.141	27.53	0.414**	0.171	37.52	0.524**	0.275
17.54	-0.348**	0.121	27.54	0.421**	0.848	37.54	0.560**	0.313
17.56	-0.334**	0.112	27.56	0.239**	0.057	37.56	0.482**	0.232
17.6	-0.121nis	0.014	27.6	0.312**	0.097	37.6	0.503**	0.253
17.62	-0.252*	0.063	27.61	0.571**	0.326	37.61	0.522**	0.272
17.63	-0.138nis	0.019	27.63	0.261**	0.068	37.62	0.592**	0.279
17.64	0.122nis	0.014	27.64	0.682**	0.465	37.64	0.648**	0.419
17.65	-0.334**	0.112	27.65	0.239**	0.057	37.65	0.476**	0.226
<b>GROUP FOUR</b>			<b>GROUP FIVE</b>			<b>GROUP SIX</b>		
Correlat ed characte rs	Correlati on coefficie nt r	Coefficient of determinati on $r^2$	Correlat ed characte rs	Correlati on coefficie nt r	Coefficient of determinati on $r^2$	Correlat ed characte rs	Correlati on coefficie nt r	Coefficient of determinati on $r^2$
4.7	0.606ns	0.367	5.7	0.235**	0.055	6.7	0.247**	0.061
47.1	0.741*	0.509	57.1	0.415**	0.172	67.1	0.310**	0.096
47.12	0.952**	0.906	57.12	0.284**	0.080	67.12	0.187nis	0.034
47.13	0.824**	0.678	57.13	0.365**	0.133	67.13	0.357**	0.28
47.15	0.892**	0.795	57.14	0.749**	0.561	67.14	0.339**	0.114
47.16	0.713	0.508	57.16	0.380**	0.144	67.15	0.447**	0.199
47.2	0.797**	0.635	57.2	0.077nis	0.006	67.2	0.067nis	0.005
47.21	0.924**	0.853	57.1	0.279**	0.077	67.21	0.187nis	0.034
47.23	0.946**	0.895	57.23	-0.033nis	0.001	67.23	0.079nis	0.006
47.25	0.829**	0.687	57.24	0.226*	0.051	67.24	-0.111nis	0.012

47.26	0.800**	0.640	57.26	0.092nis	0.008	67.25	0.181nis	0.032
47.3	0.696**	0.484	57.3	0.172nis	0.029	67.3	0.284**	0.081
47.31	0.820**	0.672	57.31	364**	0.133	67.31	0.358**	0.128
47.32	0.942**	0.887	57.32	-0.033nis	0.001	67.32	0.080nis	0.006
47.35	0.789**	0.623	57.34	0.538**	0.289	67.34	0.390**	0.152
47.36	0.726	0.527	57.36	0.159nis	0.025	67.35	0.290**	0.087
47.5	0.721**	0.519	57.4	0.592**	0.283	67.4	0.307**	0.094
47.51	0.849**	0.720	57.41	0.775**	0.600	67.41	0.342**	0.116
47.52	0.847**	0.171	57.42	0.226**	0.051	67.42	-0.111nis	0.012
47.53	0.789**	0.623	57.43	0.539**	0.291	67.43	0.390**	0.152
47.56	0.737**	0.543	57.46	0.535**	0.289	67.45	0.317**	0.101
47.6	0.625**	0.391	57.6	0.225**	0.051	67.5	0.238*	0.057
47.61	0.722**	0.521	57.61	0.358**	0.128	67.51	0.447**	0.199
47.62	0.799**	0.638	57.62	0.092nis	0.008	67.52	0.181nis	0.032
47.63	0.725**	0.526	57.63	0.159nis	0.025	67.53	0.276**	0.076
47.65	0.736**	0.542	57.64	0.537**	0.288	67.54	0.317**	0.101

coefficient of determination ( $r^2$ ) for simple and partial correlation between weight of tubers and any of the parameters per plant, number of stems, number of compound leaves, terminal leaflet area, length of primary stolons, number of primary stolons, and stem height. Depending on the parameters correlated with yield, analysis was separately arranged into six groups. Within a group, partial correlation values were calculated keeping constant any particular parameter individually and in pairs with any other parameter.

The simple correlation between number of stems and yield (Group 1) was not significant. Other researchers like Ummyia et al (2013) observed a significant correlation which is contrary to that of Majid et al (2011) possibly due to differences in environment and nitrogen level. In this research no nitrogen was applied. The corresponding partial correlation keeping constant number of compound leaves individual or with either parameters length of primary stolon or stem height was negative and significant at 5%. The calculated  $r$  values keeping constant number of compound leaves with terminal leaflet area and terminal leaflet area with number of primary stolon were negative and significant at 1%. The calculated  $r$  keeping constant length of primary stolon with number of primary stolon individually or with stem height were negative and significant at 1%. All other correlations were not-significant. Generally the correlation ranged from positive 0.026 to negative 0.396. This result is contrary to the findings of Ummyia et al (2013), Abraham et al where a positive and significant correlation were observed. Similarly, however this research obtained a negative and significant correlation, meaning, as the number of stems increases the yield decreases possibly due to diversion of nutrients from tuber filling to growth of stems particularly after anthesis. Considering the fact that additional fertilizer, as a source of nitrogen was not applied in this experiment.

Simple and partial correlation calculated between number of compound leaves and yields table 1 (group 2) were positive and significant at 1%. The  $r$  value calculated keeping constant terminal leaflet area or number of primary stolon with interaction among several vegetative character of potato in the dry season stem height was positive and significant at 5%. Generally, the  $r$  values ranged from positive 0.239 to positive 0.997. Abraham et al (2014) observed the same pattern and degree of correlation.

All simple and partial  $r$  values between terminal leaflet area and yield (Group 3) were positive and significant at 1%. They ranged from positive 0.465 to positive 0.877. Ummiya et al (2013) observed the same.

All simple and partial  $r$  values between length of primary stolons and yield (Group 4) were positive and significant at 1%. They ranged from positive 0.606 to positive 0.952. Ummiya et al (2013) observed the same direction and magnitude of correlation.

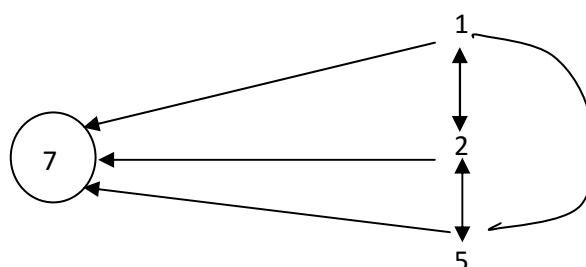
The simple correlations between number of primary stolon and yield (Group 5) was positive and significant at 5%. The corresponding partial correlation keeping constant stem height and the combination of number of compound leaves and length of primary stolon was positive and significant at 5%. The calculated  $r$  values keeping constant number of stems individually or with either parameters number of compound leaves, terminal leaflet area, length of primary stolons or stem height were positive and significant at 1%. The calculated  $r$  values keeping constant terminal leaflet area with length of primary stolons and length of primary stolons individually or with stem height were positive and significant at 1%. All other  $r$  values were not significant. Generally, the  $r$  values ranged from negative 0.033 to positive 0.775.

The simple correlation between stem height and yield (group 6) was positive and significant at 5%. Yildirin et al (1997), Abraham et al (2014) and Majid et al (2011) obtained a similar result between stem height and yield to be positive and significant. This means stem height and yield increases in the same direction due adequate amount of nitrogen as a constituent of protein for growth and tuber filling. The corresponding partial correlation keeping constant number of stems individually or with either parameters terminal leaflet area, length of primary stolon or number of primary stolon were positive and significant at 1%. The calculated  $r$  value keeping constant terminal leaflet area individually or with length of primary stolons or number of primary stolons and length of primary stolons individually or with number of primary stolons were positive and significant at 1%. The calculated  $r$  value keeping constant number of primary stolons individually was positive and significant at 5%. All other  $r$  values were not significant. Generally, the calculated  $r$  values ranged from positive 0.080 to 0.447.

### 3.2 Effect of path coefficient analysis on the yield of potato

Those parameters with greater association with yield i.e. number of compound leaves, terminal leaflet area and length of primary stolon, as suggested by the correlation analysis, the cause-to-effect relationship was studied by the path coefficient. Generally, as illustrated hereafter (figs 3 and 4) among any three causal parameters length of primary stolon exerted the maximal direct positive effect on yield. Ummiya (2013) observed the same. The path way to yield as caused by length of primary stolon was negligibly influenced by indirect effects via other parameters. The pathways to yield as caused by terminal leaflet area was due to the direct effect of that parameter (fig.3). A wide range of interactions among parameters featured in the pathways to yield as caused by number of compound leaves. The pathway to yield as caused by number of compound leaves was influenced by a positive indirect effect via number of primary stolon when any of the parameters number of stems (fig 1), stem height (fig. 2) or length of primary stolon (fig. 4) was included in the path combination. The association among any of the two parameters number of compound leaves with length of primary stolon or number of primary stolon, and number of primary stolon with number of stems was uniquely strong (significant at 1%). The respective directional changes are indicated in table 1. Together in one path combination (fig. 1), the direct effect

**Fig 1. DIRECT AND INDIRECT CONTRIBUTIONS OF THREE VEGETATIVE CHARACTERS NUMBER OF STEM/PLANT NUMBER OF COMPOUND LEVELS/PLANT AND NUMBER OF PRIMARY STOLON/PLANT TO WEIGHT OF TUBERS/PLANT OF POTATO CV.B6894-11 IN THE DRY SEASON**



1 = Number of stems/plant  
2 = Number of compound leaves/plant  
5 = Number of primary stolons/plant  
7 = Weight of tubers/plant.

**Weight of tubers/plant, g (7) and number of stems/plant (1)**

Direct effect =	-0.40961
Indirect effect via number of compound leaves =	0.03786
Indirect effect via number of primary stolons =	0.19275
Total (direct + Indirect) effect =	-0.17900

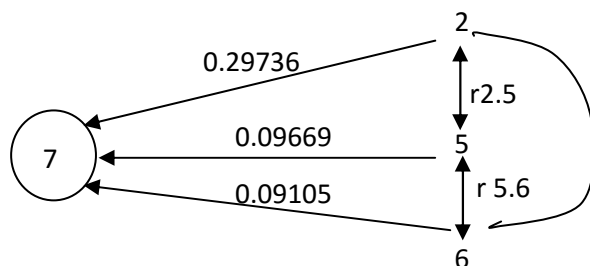
**Weight of tubers/plant, g (7) and number of compound leaves/plant (2)**

Direct effect =	0.28899
Indirect effect via number of stems =	-0.05366
Indirect effect via number of primary stolons =	0.25067
Total (Direct + indirect) effect =	0.38600

**Weight of tubers/plant, g (7) and number of primary stolons(5)**

Direct effect =	0.33934
Indirect effect via number of stems =	-0.23266
Indirect effect via number of primary stolons =	0.12831
Total (Direct + indirect) effect =	0.23499

**Fig. 2. DIRECT AND INDIRECT CONTRIBUTIONS OF THREE VEGETATIVE CHARACTERS NUMBER OF COMPOUND LEAVES/PLANT AND NUMBER OF PRIMARY STOLON/PLANT AND STEM HEIGHT/PLANT TO WEIGHT OF TUBERS/PLANT IN POTATO CV.B6894-11 IN THE DRY SEASON**



2 = Number of compound leaves/plant  
5 = Number of primary stolons/plant  
6 = Stem height/plant, cm  
7 = Weight of Tubers/Plant, g

**Weight of tubers/plant, g (7) and number of compound leaves/plant (2)**

Direct effect =	-0.29736
Indirect effect via number of primary stolons =	0.04293
Indirect effect via stem height, cm =	0.04571
Total (direct + Indirect) effect =	0.38600

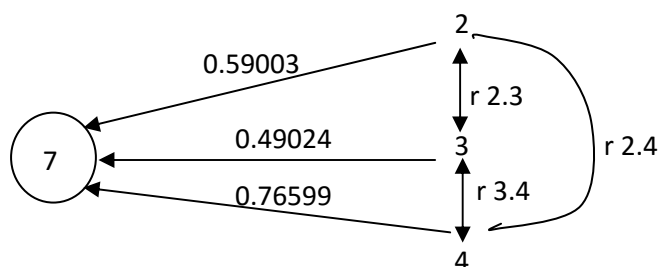
**Weight of tubers/plant, g (7) and number of primary stolons/plant (5)**

Direct effect =	0.09669
Indirect effect via number of primary stolons =	0.13202
Indirect effect via stem height cm=	0.00628
Total (Direct + indirect) effect =	0.23500

**Weight of tubers/plant, g (7) and stem height/plant (6)**

Direct effect =	0.09105
Indirect effect via number of compound leaves =	0.14928
Indirect effect via number of primary stolons =	0.00667
Total (Direct + indirect) effect =	0.24700

**FIG. 3:** Figure showing the **direct and indirect contributions of the three vegetative characters number of compound leave/plant, terminal leaflet area/plant and length of primary stolons/plant to weight of tubers/plant in potato cv. b6934-11 in the dry season**



2= Number of compound leaves/plan  
3 = Terminal leaflet area/plant, cm<sup>2</sup>  
4 = Length of primary stolon/plant, cm  
7 = Weight of tubers/plant, g

**Weight of tubers/plant, g (7) and number of compound leaves/plant (2)**

Direct effect =	= 0.59003
Indirect effect via terminal leaflet area, cm <sup>2</sup>	= 0.00049
Indirect effect via length of primary stolon	= <u>-0.20452</u>
Total (direct + Indirect) effect	= <u>0.38600</u>

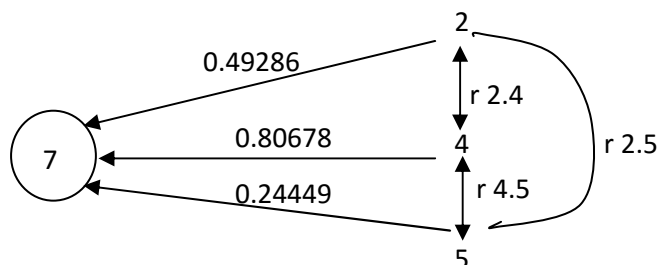
**Weight of tubers/plant, g (7) and terminal leaflet area cm<sup>2</sup> (3)**

Direct effect	= 0.49024
Indirect effect via number of compound leaves	= 0.00059
Indirect effect via length of primary stolon, cm	= -0.00022
Total (Direct + indirect) effect	= 0.48699

**Weight of tubers/plant, g (7) and length of primary stolon/plant (4)**

Direct effect	= 0.76599
Indirect effect via number of compound leaves stem	= -015754
Indirect effect via terminal leaflet area cm <sup>2</sup>	= -0.00245
Total (Direct + indirect) effect	= <u>0.60600</u>

**FIG.4:** Figure showing the **direct and indirect contributions of the three vegetative characters number of compound leaves/plant length of primary stolon/plant and number of primary stolon/plant to weight of tubers/plant in potato cv. B6934-11 in the dry season**



2 = Number of compound leaves/plant  
4 = Length of primary stolons/plant cm  
5 = Number of primary stolon/plant  
7 = Weight of tubers/plant, g

**Weight of tubers/plant, g (7) and number of compound leaves/plant (2)**

Direct effect = -0.49268

Indirect effect via length of primary stolon/plant cm = -0.21541

Indirect effect via number of primary stolons = 0.10855

Total (direct + Indirect) effect = 0.38600

**Weight of tubers/plant, g (7) and length of primary stolon/plant cm (4)**

Direct effect = 0.80678

Indirect effect via number of compound leaves = -0.03348

Indirect effect via number of primary stolon = -0.00135

Total (Direct + indirect) effect = 0.60600

**Weight of tubers/plant, g (7) and number of primary stolon/plant cm (5)**

Direct effect = 0.24449

Indirect effect via number of stem = -0.21883

Indirect effect via length of primary stolons = 0.06919

Total (Direct + indirect) effect = 0.23500

exerted on yield by either parameters number of compound leaves or number of primary stolon was positive, while that calculated for number of stems was negative. These calculations were typical of these parameters which considered separately in different path combination except number of stems in two path combination, the direct effect of that parameter was positive when terminal leaflet area, length of primary stolon or stem height were included in the path combination. The trend depicted in table 1, explains the usual  $r$  value calculated between any of these parameters and yield keeping constant, the other two parameters (table 1 group 1, 2, and 5) below:

### 3.3 Discussion

Statistically, the extent to which parameters influence each other's pathway to yield depends upon the strength of correlation among them and their respective direct effect on yield (Singh and Chaudhary, 1979). The two variables could be assessed separately. Take for example, terminal leaflet area and length of primary stolons as shown in different path combinations indicted effects on yield among this pairs of parameters were negligible and not proportional to their respectively calculated direct effects on yield (fig. 3). The same trend is shown in (figs 3 and 4), for the pairs of parameters length of primary stolons and number of compound leaves (fig. 3) for terminal leaflet area and number of compound leaves. The specific relevance of correlations among causal attributes in a pathway to yield was assessed by comparing two different parameters effects on yield via a common parameter in a single path combination in

which correlations among caused parameters are known to differ. As shown in Fig. 4, the indirect effects exerted on yield by any two parameters via the third were slightly consistent with the strength of association calculated (table 1), among causal parameters in each path combination. The two variables, correlations and direct effects, could be made to interplay and collectively assessed by comparing particular parameter's effects on yield via one pathways among which stronger correlations among the two causal parameters in a path was combined. With a stronger direct effect of the intermediate on yield. The path of a pair with such a trend was terminal leaflet areas in yield via length of primary stolons, diagrammed in different path combination (fig. 3) and the other in different path combination (fig.3) via number of compound leaves. The pathways to yield as caused by terminal leaflet area via length of primary stolons was strongly consistent with the strength of correlation (table 1) than with direct effects of terminal leaflet area on yield and a similar trend was observed via number of compound leaves. Despite the consistently high direct effects exerted on yield by terminal leaflet area, the calculated indirect effects on yield via length of primary stolons and number of compound leaves were again consistent with the strength of correlation (table 1) pertaining to each indirect effect. Though negative, the maximal reciprocal indirect effects on yield among any pair of parameters considered were those calculated among length of primary stolons and number of compound leaves (figs 3 and 4) having combined the high correlation values (significant at 1%) table 1 with greater direct effects on yield. The highly significant positive  $r$  values between length of primary stolons and yield keeping constant any of the parameters number of stems, number of compound leaves, terminal leaflet area number of primary stolons and stem height individually and in a pair wise combination at a time (table 1, group 4), is expected given the strong positive influence exhibited by length of primary stolon in the pathway considered.

### 3.4 COEFFICIENT OF VARIABILITY

Table 1.8 showed a coefficient of variability calculated for the seven parameters, after harvest, the most variable parameter was number of stems per plant with a coefficient of variability of 80.79% this is followed by length of primary stolon per plant 53.86% number of primary stolons per plant 52.98%, weight of tubers/plant 47.01, stem height per plant 39.37 and terminal leaflet area per plant 17.8% and the leaflet variable parameters since importance of variability is attached to the least variable parameter, terminal leaflet area should be considered as the most important of all parameters in terms of variation.

### 4.0 CONCLUSION

It can be concluded that those parameters with greater association with yield i.e number of compound leaves, terminal leaflet area and length of primary stolon, as suggested by the correlation analysis, the cause to effect relationship as indicated by the path coefficient (fig.1.8), among the three causal parameters length of primary stolon exerted the maximal direct positive effect on yield. Therefore the highly significant positive  $r$  values between length of primary stolon and yield keeping constant any of the parameters number of stems, number of compound leaves, terminal leaflet area, number of primary stolon and stem height individually and in pair wise combination at a time (table 1 group 4) is expected given the strong positive influence exhibited by length of primary stolon in the path way considered. Therefore, yield of potato on the Jos plateau is best determined by selecting and improving terminal leaflet area.

---

## REFERENCES

- A. Zomba, S. Z. Wayeb, A. A. Adebayo (2013) Growth and Yield Response of Irish Potato (*Solanumtuberosum*) to climate.<https://globaljournal.org> in Jos South Plateau State Nigeria. Global Journal Social Sciences Research.org .
- Abraham Lambora, YohannesPetros and MebeaselassieAndergie-(2014) Correlation and Path Coefficient Analysis between Yield and Yield Components in Potato (*Solanumtuberosum*). Plant Science Today 1(4): 196-200
- Babaji, B.A., Amame, E. B., A. M. Falaki, U.F. Chiezey, Mahmud, M. Mahadi,A. and Muhammad A. A. Contribution of Shoot, N,P and K to Tuber Yield of Irish Potato (*Solanum tuberosum*) at Samaru, Nigeria. Journal of Agricultural and Biological Sciences Vol. 2,No. 4-5, july/Sept. 2007.
- Desai, N. C., Jaimini. S. N. (1998) Correlation and Path Analysis of Some Economic Characters in Potato. Journal of the Indian Potato Association 25(1/2) 25-29 (En, 25 ref) Gujarat Agricultural University Narsari396450, India.
- Fontes, P. C. R., Finger,F. L. (1999) Tuber Dormancy Aerial Growth and Tuber Formation of Potato 20 (197) 24-29 (Pt, 18 ref).
- J. Muthoni, D. O Nyamnigio- J. Horti (2009) Academic Journal.org.
- MajidKhayatnezhad Reza ShahriariRozaGholamin, ShahzadJamaatine- Somarin and RoghayyaeZabihi-e-Mahmoodabad (2011) Correlation and Path Analysis Between Yield and Yield Components in Potato (*Solanum tuberosum* L.) Middle-East Journal on Scientific Research 7(i): 17-21.
- Maine, M. J. DE, Simpson, G. (1999) Somatic Chromosome Number Doubling of Selected Potato Genotypes Using Callus Culture or the Colchicine Treatment of Shoot Nodes in Vitro. Annals of Applied Biology 134(1) 125-130 (En, 8 ref.) Scottish Crop Research Institute. Invergonrie Dundee DD2 5DH U.K.
- Marian G. Kratzke, Jiwan P. Palta(1992), Variations in Stolon Length and in Incidence on Tuber Root Among Eight Potato Cultivars. American Potato Journal, Vol. 69 Issue 9, pp 561-570
- Randal, C. (1993) Potato Health Management. Rowe (Ed), APS.
- UmmyiaH.M., Khan S. A., Jabeen N., Junaif, N., Hussain, K.( 2013) Intertrait Relationship and Path Analysis in Potato vol. 45 / Issue/ 201-205.
- Uranbey, S. E., C. Basalma,D. (1999) Correlation Among Stolon Length, Stolon Number, Plant Height and Tuber Yield in Potato. Turkish Journal of Field Crops. 3(2) 37-39 (En, 7 ref) Ankara University, Faculty of Agriculture Department of Field Crops, Diskapt, Ankara, Turkey.