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***Research Article***

# STUDYING THE CORRELATION AND STEPWISE REGRESSION ANALYSIS BETWEEN YIELD AND YIELD COMPONENTS OF POTATO HYBRIDS RESULTING FROM CROSS OF LUKA AND CAESAR CULTIVARS UNDER FIELD CONDITION

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## ABSTRACT
To study the correlation between traits and regression analysis between potato hybrids resulting from the cross of Luka and Caesar cultivars, we conducted an experiment based on accidental Augment design in Agricultural Research and Natural Resources Station in Ardabil during 2013. The results from studied variance analysis in hybrids from Luka and Caesar cultivars showed that there is a significant difference between traits including number of days to tuberlization, plant height, main stem number per plant, main stem diameter, and tuber number per plant, average tuber weight, tuber weight per plant and tuber yield. Correlation coefficient indicated that there was a significant and positive correlation between tuber weight per plant and tuber number per plant (r=0.74) at 1 % probable level. There was a significant and positive correlation between tuber yield and tuber number per plant (r = 0.742**) at 1% probable level. The correlation between tuber yield and tuber weight per plant (r=0.999**) was significant and positive at 1% probable level. Tuber yield was of the highest correlation with tuber weight per plant (0.999**) among all these traits. Multi-regression analysis in stepwise method for tuber yield showed that variables having significant impacts and those that maintained in the equation are plant height and main stem number per plant. The breeding expressive coefficient in the fitted model was 0.996** showing the 99% justification of present variations in tuber yield by plant height and the number of main stem per plant. The results from variance analysis and T-test confirm the significance of each coefficient. Generally, both traits plant height and the number of main stem should increase to heighten the tuber yield.

***Keywords:*** *Potato, Correlation, Stepwise Regression, Yield*

## INTRODUCTION
Potato has different and much species that from its various species, there are agricultural species called *Solanum Tubberesum* that are consumed by humans (Mehtarinia, 1999). Agricultural varieties and production clones are reproduced asexually by tuber. The important characteristic of potato is its asexual production that causes genetic fixation. So every selected species from germ plasma will be constant, and new varieties are selected from F1 generation (Damak *et al.*, 1996).
This product has a special importance for developing countries due to increasing potential in area unit and time unit and has more nutritive value to keep and hold increasing undernourished and hungry population. After milk, it is the first product that can take into account as a complete food. Except fat, it has all minerals, amine acids and starch and is a good source for required sugar and is full of energy (Rezai and Soltani, 2002). Due to importance of potato in production of food, in comparison with 20 major foods, based on wet weight, it has allocated sixth rank in developing countries and fourth in developed countries of the world. Annual production of it in Iran with more than 4.5 million tons has allocated third rank after wheat and rice to itself (Hossein-Zadeh *et al.*, 2002; Hassanpanah *et al.*, 2005). Value of produced protein of potato as 1.4 Kg ha-1 in day, has allocated first rank from producing energy as 216 mega joules in hectare among products to itself and value of produced dry material is 2.2 tons in hectare. 74.5% per area unit has more nutritive energy in comparison with wheat and 58% more than rice. Generally, there is a weak correlation among weight of thousand seed and performance of bush. Though genetic variety exists for 1000 weight seed, this choice has negative effect on other performance components for weight of high

thousand seed (Falahi, 1998). In general; there is a poor correlation between 1000 grains yield and plant yield. Although there is a genetic variation for 1000 grains weight, the selection for a high 1000-grain weight has a negative effect on yield components.

Kandil (1983) concluded from their experiments that there is a meaningful relation between traits of branches per plant, number of pods per plant and one thousand grains weight and the trait grain yield. The trait number of pods per plant has the largest direct and indirect effects on grain yield. Ghosh and Mukhopadhyay (1994) reported that one thousand grains weight had a low direct positive effect on grain yield. Kandil *et al.,* (1995) reported that number of pods per plant has a significant effect on one thousand grains weight and 40% of the variation is explained by this trait. Therefore in this study by determining the role and contribution of each component on the grain yield, we can specify the performance indicators which can be selected for modification.

## MATERIALS AND METHODS

This research was conducted in Agricultural Research Station and Natural Resources in Ardabil during 2013 studying the phonological and morphological traits in 166 hybrids. The Agriculture Research Station of Ardabil has been located in 12 km Ardabil to Khalkhal road, 1350 m higher than sea level with semi-arid and cold climate with average rainfall 310.9 mm in the last 30 years and average annual minimum and maximum temperature of -1.98 and 15.8c. In this experiment 166 selected hybrids from quits of Luka cultivar (as mother) and Caesar cultivar (as father) with parents of these hybrids as a control, were studied and cultured based on Augment experimental design in three blocks. The hybrids were cultivated in 2 m length in a row of 75 cm distance and the distance between 2 plants was 25 cm. the father of this hybrid (Caesar cultivar) had a round egg-shaped tuber, yellow flesh, shallow eye, yielding, and water deficit to tolerant and good for fresh using.

The female parent of this hybrid (Luka) has extended tuber shape, yellow flesh, red skin, shallow eye, 100-days growth period, high dry mater percent, yielding and good for frying. 150 g Ammonium Phosphate per hectare was used twice (50% in planting and 50% in tuberlization time), 350 kg Urea was used per hectare in three times (25% in planting, 50% in greening and 25% immediately after tuberlization) and 150 kg Potassium Sulfate was used once (in planting) based on Soil Test. 250 ml Confidor poison was used per hectare twice to control the coloroda beetles. This was done twice before tubrization and manual harass to control the weeds.

The traits days' number to tuberization , days' number to physiological maturation, main stem number per plant, main stem diameter, plant height, number and weight of tuber per plant, average tuber weight and tuber yield were measured and noted during growing and after physiological maturation of hybrids. The data from measuring studied traits in hybrids were analyzed by Augment design software in Agriculture Statistics Research Institute in India. The simple correlation coefficients were calculated to study the relation between the traits. To calculate it we used SPSS-16 software. Multiple regression analysis was done in stepwise using Minitab16 software for tuber yield.

## RESULTS AND DISCUSSION

The results from variance analysis of studied traits in the hybrids from cross of Luka and Caesar cultivars during 2013 showed that there is a significant difference between blocks in number and weight of tuber per plant, average tuber weight, tuber yield, plant height, number and diameter of main stem per plant and days' number to tuberlization in studied hybrids.

So the hybrid mean was corrected in all measured traits. There was a significant difference in number and weight of tuber per plant, average tuber weight, tuber yield, plant height, main stem number per plant, main stem diameter and days' number to corrected and dis-corrected tuberlization in studied hybrids. There was a significant difference between traits including average tuber weight and tuber yield in control group and the average of number and weight of tuber per plant, average tuber weight, tuber yield, plant height, main stem number per plant, main stem diameter and days' number to tuberization in hybrids (Table 1).

**Table 4.1: Mean squared traits in hybrids from population Luca ♀ × Caesar cultivars ♂**

| S.O.V | df | Mean of Square | | | | |
|---|---|---|---|---|---|---|
| | | Tuber number per plant | Tuber weight per plant | Tuber yield | Tuber weight average | Plant height |
| Block (uncorrected) | 3 | 109.3** | 2349672.4** | 6183.9** | 51679.37** | 1308.27** |
| Treatment (uncorrected) | 167 | 30.9** | 302390.5** | 859.1** | 241322.92** | 120.91* |
| Treatment (corrected) | 167 | 29** | 260846.8** | 749.9** | 23248.63** | 97.98* |
| Error | 3 | 0.46 | 10982.8 | 24.2 | 196.81 | 57.58 |
| Between controls | 1 | 0.12 | 2.82 | 144.15** | 466.49** | 0.007 |
| Between hybrids | 165 | 2.06** | 2639329.01** | 757.44** | 23463.82** | 98.10* |
| Between hybrids vs. control | 1 | 42.51** | 1189.02* | 33.98** | 9814.91** | 107.12* |
| The coefficient of variation (percent) | - | 8.85 | 11.33 | 10.01 | 9.85 | 12.76 |
| R-square | - | 0.99 | 0.98 | 0.98 | 0.99 | 0.99 |
| Average | - | 7.65 | 924.70 | 49.10 | 142.39 | 59.43 |

** and ** Significantly at p < 0.05 and < 0.01, respectively*

**Continue Table 1-**

| S.O.V | df | Mean of Square | | |
|---|---|---|---|---|
| | | Main stem number per plant | Main stem diameter | Day's to tuberization |
| Block (uncorrected) | 3 | 3.39** | 10.84** | 46.38** |
| Treatment (uncorrected) | 167 | 1.34* | 6.04** | 22.837** |
| Treatment (corrected) | 167 | 1.28* | 5.88** | 22.08** |
| Error | 3 | 0.25 | 0.59 | 2.38 |
| Between controls | 1 | 0.42 | 0.004 | 6.017 |
| Between hybrids | 165 | 1.28* | 5.83** | 20.89** |
| Between hybrids vs. control | 1 | 1.12* | 17.56** | 198.87** |
| The coefficient of variation (percent) | - | 21.25 | 16.29 | 7.97 |
| R-square | - | 0.99 | 0.96 | 0.98 |
| Average | - | 2.35 | 12.27 | 78.47 |

** and ** Significantly at p < 0.05 and < 0.01, respectively*

The simple correlation among different traits is shown in the Table 2. There was a significant and positive interrelation between tuber weight per plant and tuber number per plant (r = 0.74) at 1% probable level. There was a significant and positive interrelation between tuber yield and tuber number per plant (r = 0.742) at 1% probable level. There was a significant and positive interrelation between tuber yield and tuber weight per plant (r = 0.999) at 1% probable level (Tables 2). Jouyandeh (2013) showed that there was a positive and significant correlation between total tuber yield and marketable tuber yield per plant, average tuber weight and the percentage of dry matter percent at 1% probable level. Fathi (2004) showed that there is appositive and significant correlation between plant height and tuber yield at 1% probable level. Poozeshi *et al.*, (2004) used crown canker of potato to study the resistance of potato varieties against mushrooms AG-3 and the correlation coefficients was significant among all four traits at1%probable level. Jafarzadeh (2010) suggested that based on the results from experiments both traits seed tuber yield and tuber number per plant had direct and positive effect on tuber yield and any breeding actions may increase yield to improve these traits.

**Table 2: The simple correlation coefficients among evaluated traits**

| | Day's to tubrization | Plant height | Main stem number per plant | Main stem diameter | Tuber number per plant | Tuber weight per plant | Tuber weight average |
|---|---|---|---|---|---|---|---|
| Plant height | -0.12 | 1 | | | | | |
| Main stem number per plant | -0.22 | 0.148 | 1 | | | | |
| Main stem diameter | 0.137 | 0.244 | -0.24 | 1 | | | |
| Tuber number per plant | -0.053 | 0.126 | 0.15 | 0.06 | 1 | | |
| Tuber weight per plant | -0.067 | 0.137 | 0.066 | 0.014 | 0.74** | 1 | |
| Tuber weight average | -0.035 | 0.036 | -0.12 | 0.14 | -0.38 | -0.27 | 1 |
| Tuber yield | -0.064 | 0.136 | 0.066 | -0.012 | 0.742** | 0.999** | 0.27** |

** and ** Significantly at p < 0.05 and < 0.01, respectively*

First the independence rest of pilot errors were performed using Durbin Watson and showed that the errors are independent of each other. The Durbin Watson test is used to study the auto-correlation of residuals in regression. The stepwise regression was used to determine the most important effective traits on tuber yield of hybrids and justification of these interrelations. If there is an auto-interrelation in errors, it is impossible to use linear regression. To study this assumption Durbin Watson test is used. The statistics value of Durbin Watson ranges from 0 to 4. If there is no serial correlation between residuals, then the value of the statistic should approach 2. If it approaches to zero, so there is a positive correlation and if it approaches to 4, the correlation is negative (Flizmoser *et al.*, 2005). The stepwise linear multiple regression analysis was used between tuber yield (ton per hectare) as a dependent trait (y) and other studied traits as independent trait (x) to study the effected each trait on tuber yield. The cultivars with significant effect remained in equation were plant height and main stem number per plant. The correction coefficient in the fitted model was 0.996 indicating 99% justification of variations in tuber yield using the plant height and main stem number per plant (Table 3).

**Table 3: Stepwise regression analysis of variance**

| S.O.V | df | SS | MS | F |
|---|---|---|---|---|
| Regression | 2 | 142778.743 | 71389.372** | 2.233 |
| Residual | 165 | 527.447 | 3.197 | |
| Total | 167 | 143306.190 | | |

*R2 =0.996***
*Durbin Watson =1.709*
*** Significantly at p < 0.01, respectively*

Showing that among the mentioned cultivars the two varieties c6 (plant height) and c3 (main stem number per plant) justify more than 99% tuber yield variations, the following model showed that
Y = -0.52+0.053c6+0.241c3
Y = yield
C3 = main stem number per plant
C6 = plant height
Both traits plant height and main stem number per plant should increase to improve the tuber yield, the results from variance analysis and T-test approves the significance of each coefficients. Jafarzadeh *et al.*, (2010) showed that the explanatory coefficient of model in seed tuber yield and main stem number per

plant was 96-99% in regression method in tuber yield and its components by introducing the traits including number and weight of tuber per plant and the best model was fitted. Jouyandeh (2013) reported that the tubrlization, plant height, main stem number per plant, main stem diameter, tuber weight per plant and tuber number per plant in studied hybrids are remarkably important in selecting the higher tuber yield. Nasri *et al.*, (2012) used regression analysis to study the correlation between traits and analysis of quality and quantity of causative yield of beet in which the explanatory coefficient was 0.994, that is, nearly 100% yield variation of root was justified.

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