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Original Contribution

ANALYSIS OF THE CORRELATION AND REGRESSION COEFFICIENTS OF THE INTERACTION BETWEEN YIELD AND SOME PARAMETERS OF SNAP BEANS PLANTS

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ABSTRACT

Determination of correlation, regression coefficient and coefficient of determination between the yield of snap bean with some parameters of growth and plant development, shows the interaction between them and the significance of these relationships. The results showed that the yield was highly related to significant differences among the pods fresh weight/experimental unit (r=+++ 0.996), the index of productivity (r=+++ 0.839), pods fresh weight/ plant (+++ 0.774), pods number/plant (r=++ 0.508). There was a negative value of correlation coefficient between yield and the weeds infestation (number and fresh weight) in the sown field on one part and the snap bean plants is (r=- - 0.637).

Key words: snap bean, correlation coefficient, parameters, yield

INTRODUCTION

Correlation is a measure of the relationship between two or more variables The measurement scales used should be at least interval scales, but other correlation coefficients are available to handle other types of data. Correlation coefficients can range from -1.00 to +1.00. The value of -1.00 represents a perfect *negative* correlation while a value of +1.00 represents a perfect *positive* correlation. A value of 0.00 represents a lack of correlation.

Results of analysis of the interaction of yield from some parameters of snap bean plants- quality of bean production, physiological process during growth and development of plants, chemical contents of pods-macro and micro nutrients gave valuable information about which steps of agro techniques of snap bean growing needs more attention to enhance best quality and quantity of yield. Between the symptoms of live organisms there are dialectic relations, which influenced each others and depended on the abiotic factors of environment affected on their formation. This relation some time could be determined very easily, but often must be determined exactly (Zaprianov, 1983). Examples of this include: plant productivity related with the efficacious plant nutrition with its interaction with other factors of the environment (humidity, temperature, light conditions etc.), any change in the values of each factor results in many other changes.

RESULTS AND DISCUSSIONS

1. *Main part of the quality parameters of snap bean pods related with positive correlation coefficient with yield of plants(r=++0.351 to +++0.996)*

Table 1 shows high step of correlation coefficient with significant differences between the fresh weight of pods from the experimental unit and the yield (r=+++ 0.996), followed by the index of productivity which expresses the fresh weight of pods, length and width(r=+++ 0.839) and with fresh weight of snap bean pods (r=+++ 0.774). The results show high correlation coefficient between the yield and number of pods formation per plant(r=++0.508) and between the yield and fresh weight of snap bean plant (r=++ 0.351), as shown in **Figure 2**.

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Table 1: *Correlation and determination coefficient between yield and some parameters of snap bean plants*

№	Relations between yield and :	coefficients:	
		correlation r	determination r ^{2}
	Morphological parameters		
1	Plant density, number	+ 0.131	0.017
2	Index of productivity, K	+++ **0.839**	**0.704**
3	Plant height after 1st treatment, cm.	+ 0.159	0.025
4	Plant height after 2nd treatment, cm.	+ + **0.351**	0.123
5	Leaves number/plant after 1st treatment	- 0.093	0.009
6	Leaves number/plant after 2nd treatment	- 0.024	0.001
7	Flowers/plant, number	+ 0.064	0.004
8	Fruits (pods)/ plant, number	++ **0.508**	0.258
9	FW of snap bean plants, g., after 1st treatment	++ **0.351**	0.123
10	FW of snap bean plants, g., at harvest time	+ 0.295	0.087
11	Pods/plant, number	+ 0.186	0.035
12	Pods weight/plant, g.	+++ **0.774**	**0.598**
13	Pods weight/experimental unit, g.	+++ **0.996**	**0.992**
	Index of weed and disease injury by snap bean plants		
1	Weeds number /experiment unit after I-st treatment	-- **0.637**	**0.406**
2	Weeds number /experiment unit at harvest time	--- **0.686**	**0.471**
3	Weed FW/experimental unit at harvest time, g.	--- **0.659**	**0.434**
4	FW of MW after I-st treatment. g.	-- **0.550**	**0.302**
5	FW of DW after I-st treatment. g.	--- **0.665**	**0.442**
6	Phytotoxicity from pesticides	+ 0.088	0.010
7	Disease injury by snap bean plants	- 0.040	0.002
8	Disease injury by snap bean pods	- 0.025	0.001

FW=fresh weight; PW=pods weight; MW=Monocotyledons; DW=Dicotyledonous

Y = -25,9592 - 0,018 M - 0,1695 W + 6,6283 L - 0,6553 Lm + 47,6641 Lv	R	SEE	P<
	0,997	5,15	0,00001

Where:
1. Parameters of the equation
R – coefficient of determination; SEE – standard error; p< - statistical significance
2. Members of the equation
У - yield, kg/dka
M - fresh weight of 10 plants/m^2
W-weeds/m^2
L – pods number, n
Lm – pods weight , g
Lv - pods /variant, n

The value of correlation coefficient twice increased (r=++ 0.351) to express the relationship between the yield and plant height after the second treatment with pesticides and suspensions of leaf fertilizer, *Lactofol*, in comparison with the first treatment (r=+ 0.159). **Figure 1** shows the analysis of the degree of weed infestation (number and fresh weight). There is negative influence on growth and development, especially fruit setting. Phytotoxicity on the snap bean plants after the first and second treatments with pesticides+, foliar fertilizer *Lactofol* and the injury by disease on snap bean plants and their pods shows low value of the correlation coefficient. These results may be related with the physiological function of the leaf fertilizer *Lactofol* to decrease the negative effects of pesticides and diseases, as shown on **Table 2**.

After the treatment of snap bean plants with pesticides and foliar fertilizer, the quantity of yield, decreased by the degree of weed infestation in the sown field; the correlation coefficient expressing this interaction is (r=- - 0.637) after the first treatment. Approximately it is the same at the harvesting time (r=- - - 0.686). The analysis of the correlation between the yield and the fresh weight of the weeds at the harvesting time confirms the same mentioned tendency. The correlation coefficient between them is (r=- - 0.659), as shown in **Figure 3**. The values of the correlation coefficient between yield of

snap bean plants and the degree of weeds infestation at the harvest time are with high negative expression (r=- -0.550 to - - -0.690).

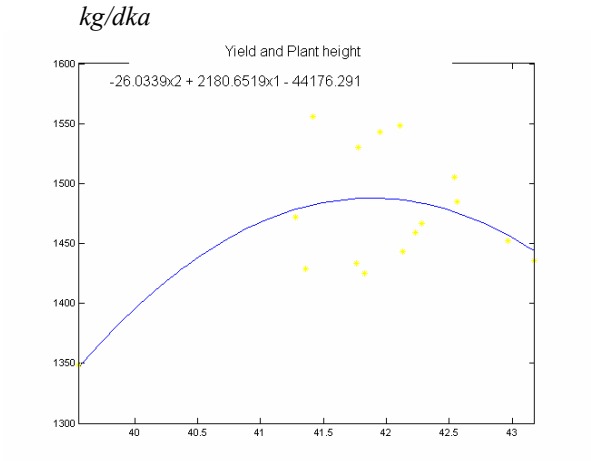

Figure 1: *Regression equation for yield and plant height*

The partial analysis shows that the dicotyledonous weeds have the highest negative effect (r=- - - 0.665) on the yield of snap bean plants, compared to the effect of monocotyledons ones(r=- - - 0.665).

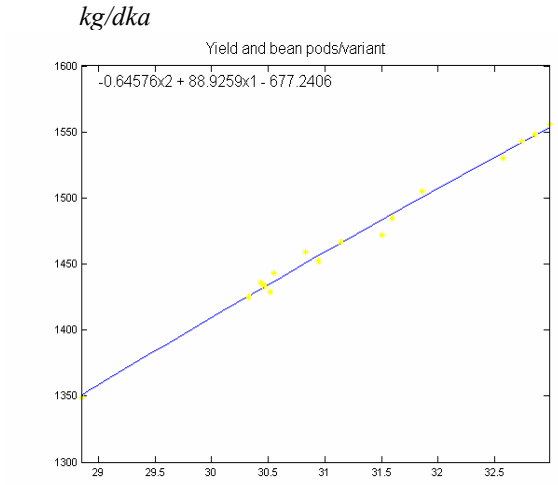

Figure 2: *Regression equation for yield pods/ experimental unit*

Injuries on snap bean plants caused by application of different modifications of suspensions of foliar fertilizer *Lactofol* mixed with pesticides are of low degree on the growth and development of vegetable crop plants. The value of correlation coefficient between the yield and these injuries is(r=+ 0,088). The reason for the low correlation coefficient may be due to the presence of macro and micronutrients in the applied fertilizer and the pesticides, which help snap bean plants to overcome the negative effects. The value of the correlation coefficient between the yield and the density of snap bean plants in the sowing field is (r=+ 0,131), with the flowers (number per plant) being, (r=+ 0,064). This low level of correlation coefficient may be due to the following reasons: that snap bean plants form high number flowers with low fruit set percentage related with unfavourable climatic conditions (high air temperatures with low humidity) during the vegetation of the dwarf bean cultivars in Tricia region, where the experiment had been achieved and with the dry matter in the pods was(r=+ 0,0684).

The coefficient of determination r^2*, which represents the proportion of common variation in the two variables (i.e., the "strength" or "magnitude" of the relationship)*
In order to evaluate the correlation between variables, it is important to know this "magnitude" or "strength" as well as the *significance* of the correlation. It expresses the amount of common variation between the two variables. The results of analysis of the significance of the relationship between the fresh weight of snap bean pods per experimental unit and the yield show that it could be determined by the total quantity of the yield. The value of the determination coefficient (DC) between the mentioned factors is 0.992, followed by the value of DC of the index of productivity (0.704). The partial effect of the fresh weight limited by the yield is so high (0.598) in comparison with the limiting effects of the number of pods per plant on the quantity of the yield (0.258). The limiting ability of the weed infestation on the yield quantity is obvious. DC varied from 0.302 by monocotyledons to 0.434 for fresh weight of weeds during the harvesting time and 0.442 for dicotyledonous weeds species.

The negative effects of weed infestation in sowing snap bean field increased from 0.406 after the first treatment with mixed application of fertilizer *Lactofol* with pesticides to 0.471 during the harvesting time of snap bean yield.

Yield of snap bean plants depends on positive significant value from the pollen fertility and formatted pods number. The correlation coefficient between them was (r=++ 0,438; + + 508). These results logically confirm the conclusion: flower formation in snap bean plants usually does not correlate with yield (Kumanov et all 1988). The relationships between some morphological parameters (leaves number, plant height, plant fresh weight) during the earlier period of the ontogenetic development stages and yield of snap bean plants have different values. The

correlation coefficient between plant height, plant fresh weight and yield has positive values. Snap bean yield related with pods fresh weight has correlation coefficient (+ 0.205), pods length (- 0.004), pods width (+ 0.096), grains number per pod (+ 0.120), pods number per experimental unit (+ 0.281), and pods number in one kilogram (- 0.204).

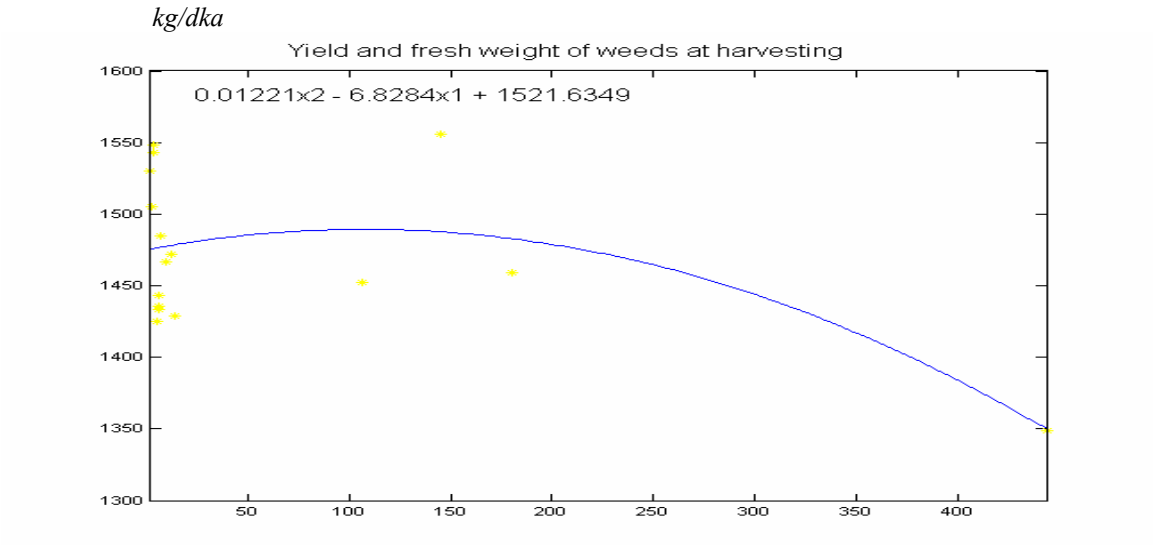

Figure 3: *Regression equation between yield and fresh weight of weeds at harvest*

Physiological process in snap bean plants during their growth and development has specific effects on their productivity. Pollen fertility is the main factor affecting yield (++ 0.438) followed by stomatal conductivity (++ 0.356) intensity of photosynthesis (+ 0.224), transpiration (+ 0.174) and peroxidase activity (+ 0.151). See **Table 2**.

Table 2*: Correlation and determination coefficient between yield and some parameters of snap bean plants*

	Relations between yield and:	**coefficients:**	
		correlation r	**determination r ^{2}**
	Physiological parameters		
1	Pollen fertility	++ **0.438**	0.192
2	Transpiration	+ 0.174	0.030
3	Photosynthesis	+ 0.224	0.050
4	Stomata	++ **0.356**	0.127
5	Peroxidase activity	+ 0.151	0.023
6	Catalase activity	+ 0.010	0.000
	Plastid pigments		
1	Dry matter, %	+ 0.068	0.005
2	Chlorophyll “a”	+ 0.074	0.005
3	Chlorophyll “b”	- 0.004	0.000
4	Carotinoids “c”	+ 0.031	0.001
5	Total plastid pigments “a” + “b” + “c”	+ 0.051	0.003
	Macro and microelements in grains		
1	*N- content*	- 0.167	0.030
2	*P- content*	+ 0.280	0.080
3	*K- content*	- 0.099	0.010
4	*Ca- content*	++ **0.570**	**0.330**
5	*Mg- content*	+ 0.260	0.007
6	*Mo – content*	+ 0.152	0.030
7	*Mn – content, mg*	- 0.161	0.030
8	*Cr – content, mg*	++ **0.360**	0.130

Plastic pigment contents in leaves of snap bean plants treated with suspensions of the foliar fertilizer *Lactofol* and pesticides show unequal effects on the yield. Synthetic

process of *Chlorophyll a*, shows a negative sign (- 0,074) with the yield, while *Chlorophyll b* shows a yield relationship with correlation coefficient (- 0,004). The same tendency exists between the content of total plastid pigments and dry matter in the pods, which relates with yield as (+0,051, + 0.064) respectively.

Contents of macro and micronutrients relate with different values of the yield of snap bean pods. The major value between them can be found with calcium (Ca) contents in the pods (+0,570), followed by chrome (Cr) content (++ 0.370), phosphorus (P) content (+ 0.280), magnesium Mg (+ 0.260), molybdenum (Mo) and manganese (Mn) (+ 0.161). The correlation coefficients between the yield and nitrogen (N) and potassium (K) contents in the pods of snap bean are (- 0.167, - 0.099), respectively.

The results of the coefficient of determination between the yield and the intensity of the physiological process and parameters, which represent the proportion of common variation between them (i.e., the "strength" or "magnitude" of the relationship)

It is important to know this "magnitude" or "strength" as well as the *significance* of this correlation. The coefficient of determination of yield with the intensity of the physiological process is not so high and varies from 0.023 – 0.030 (peroxidase activity and transpiration intensity respectively) followed by 0.050 for photosynthetic intensity and 0.127 for stomatal conductivity. The value of coefficient as found between yield and the pollen fertility confirms our results about the correlation coefficient.

Similar results showing the significance of the correlation between the contents of plastid pigments, macro and micronutrients and yield have already been established. The coefficient of determination varies from (0.001 to 0.005) for *Chlorophyll a* and 0.030 for N, Mo, Mn contents to 0.080 for P, 0.130-Cr and 0.330-Ca.

CONCLUSION

- The significance of coefficient of correlation and its expression as coefficient of determination between the yield components (yield of fresh weight of snap bean pods/ experimental unit, index of productivity, fresh weight of pods /plant and fresh weight of whole snap bean plant) and the total yield was very high with positive sign. The values differed from (r=+++ 0.996 r^2 =0.992), (r=+++ 0.839 r^2 =0.71), (r=+++ 0.774 r^2 =0598), (r=++ 0.508 r^2 =0.258) respectively.
- The significance of coefficient of correlation between the yield and the pollen fertility was (++ 0.438). The correlation coefficient between the yield and stomatal conductivity was (++ 0.356), a positive index.
- Contents of macro and micronutrients related with different values of the yield of snap bean pods. The major value between them was found with calcium (Ca) contents in the pods (+0,570), followed by chrome (Cr) content (++ 0.370), phosphorus (P) content (+ 0.280), magnesium Mg (+ 0.260), molybdenum (Mo) and manganese (Mn) (+ 0.161). The correlation coefficients between the yield and nitrogen (N) and potassium (K) contents in the pods of snap bean were (- 0.167, - 0.099), respectively.

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