

## **Nitrogen nutrition impact on quantitative traits of early potato (*Solanum tuberosum* L.)**

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### **Summary**

Field trial was conducted on farming household in Jasenica (area of Bosnia and Herzegovina) with three potato varieties *Solanum tuberosum* L. (cv. Liseta, Cleopatra and Adora). The experiment was set up in randomized block design scheme in three replications. For side dressing we used three nitrogen doses (N 100, N 200 and N 300 kg N/ha) plus control plots (N 0 kg/ha). Data were being collected during two years 2004 and 2005. We applied half of dose of total nitrogen amount in pre-planting and the other half 45 days after the planting. The objective of this research was to estimate influence of different nitrogen doses on optimal tuber yield. We also established percentage of nitrogen, dry matter and raw ashes in potato tuber. We have observed numerical data on plant sites, number of haulm per plants and biomass of potato plant per treatments. Data were processed with SPSS software. Results of ANOVA test shows that nitrogen nutrition affects on the yield and other traits of potato crop. This research shows that timing and application of correct quantity of nitrogen nutrition results in yield increments.

### INTRODUCTION

Nitrogen is very often element in diagnoses of crop needs. Proper N fertilization is crucial for optimizing potato yield and quality (7). Field studies showed that excessive apply of nitrogen not only reduces quality of the tuber but it also reduces yield by promoting vigorous vegetative growth. It's important, for two reasons, to know the nitrogen demands in potato crop. The first one is excessive use of nitrogen nutrition increases economical costs and the second one is negative effects on environmental problems associated with leaching and runoff. These are the reasons for

establishing optimal needs of nutrients in the crop. Significant interaction happens between nitrogen and water supply and excessive combination brings to decreasing of yield (6). Dry matter weight increased with applied nitrogen fertilizers because nitrogen acquirement is better by adding nitrogen in the soil (2). Besides the fertilization a great influence on dry matter weight could have environment conditions (3). Balanced nutrient supply is necessary for adequate biomass production and yield stability as well as for good quality (5, 9). Differences between the nutrient demands of crop depend on genetically characteristics of species and varieties. High yield levels can only be ensured by adequate supply of nutrient elements, according to the requirements of the crop (4). The number of active haulms per plant is a variable linked to the differences in total tuber yield among cultivars (8) and in tuber size distribution (11).

Issue of this paper research is to determine optimum quantity of nitrogen for obtaining high yield and quality of potato tuber and to establish influents of nitrogen nutrition on biomass of plant per treatment and other quantitative traits of potato

#### MATERIAL AND METHODS

Field trial was conducted in Jasenica in 2004 and 2005 year, with three early potato varieties (cv. Adora, Cleopatra and Liseta). For both years seeds were sown in Mart in experimental plots with space between rows 0.70 m and in a row 0.20 m. Three different doses of nitrogen nutrition (N 100, N 200, N 300 kg N/ha) including unfertilized-control plots (N 0 kg N/ha) were distributed in randomized block design with three replication. Size of the experimental plots was 270 m<sup>2</sup> and data considered for evaluation were taken from central plot of 30 m<sup>2</sup>. Soil fertilization with phosphorus and potassium was determined on the basis of soil analyses. The measuring was performed on three agronomic characteristics (percentage of dry matter weight of yield, percentage of nitrogen on dry matter basis, percentage of raw ashes), and on four morphological traits (density of plants sites, number of haulms per plant, plant biomass, yield mass). Measurement for named traits was determined on five plants per treatment. Total nitrogen concentration of potato tuber was analysed by Kjeldahl method (1). Analyses of variance (ANOVA) were used for testing differences in agronomic and morphological continued traits. Pearson's correlation model was used for identifying correlations between: first and second year of total nitrogen determinate on dry matter basis, total dry matter for the two years (*DM*), total raw ashes for the two years. Data were analysed by using SPSS for Windows v 13.0 (10).

## RESULTS AND DISCUSSION

During this paper research we tried to determine influence of increasing doses of nitrogen fertilizers on percentage nitrogen determinate on dry matter basis, percentage of dry matter weight, percentage of raw ashes and plant biomass. Ascertain yield and quality of potatoes in our pots has shown efficiency of nutrition treatments, but they have also depended on some agro ecological terms of production. In potato production the most important component is yield which presents main indicator of productivity and economical profit.

**Table 1.** ANOVA test for potato yield per plant and total percentage of nitrogen on dry matter weight of potato tuber for 2004 and 2005 year

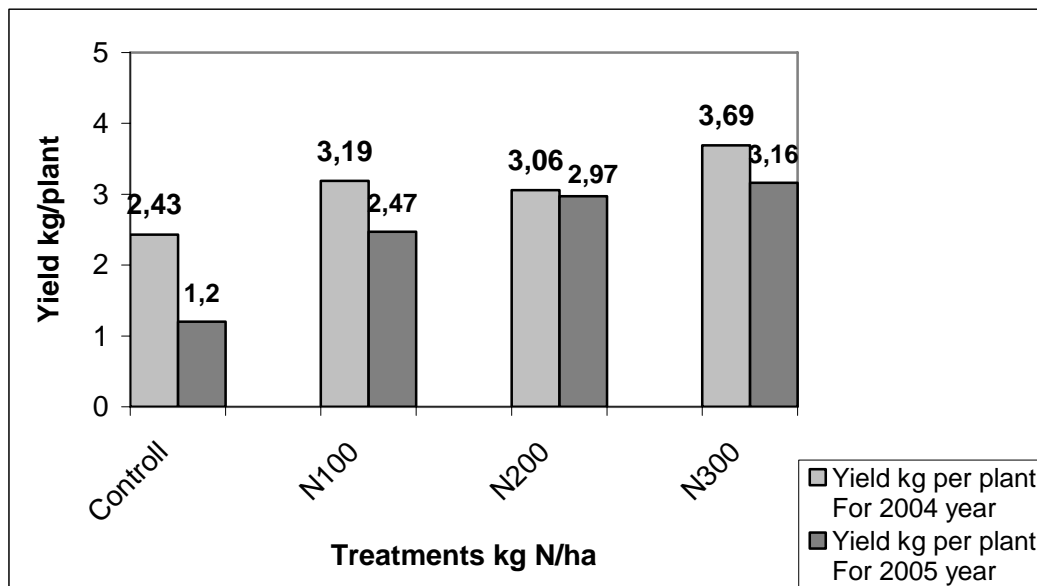
<i>Treatments</i> Kg N/ha	<i>% N on DM basis for 2004 year</i>	<i>Yield Kg per plant for 2004 year</i>	<i>% DM for 2004 year</i>	<i>% N on DM basis for 2005 year</i>	<i>Yield Kg per plant for 2005 year</i>	<i>% DM for 2005 year</i>
<i>Controll</i>	1,1	2,43	22,16	1,64	1,20	22,16
<b>N100</b>	1,2	3,19	21,87	2,32	2,47	20,30
<b>N200</b>	1,3	3,06	22,06	2,76	2,97	18,63
<b>N300</b>	1,5	3,69	20,91	2,55	3,16	19,41
<b>Treatment (T)</b>	**	*	NS	NS	**	*
<b>Varieties (V)</b>	**	*	**	NS	**	NS
<b>T×V</b>	**	NS	NS	NS	NS	NS

\* Significant at the  $P<0.05$  level; \*\* Significant at the  $P<0.01$  level; NS-non significant

Analysis of variance (table 1.) showed significant differences among total potato yield among vegetation season and the highest yield has been obtained in 2004 year for variety *Adora*. In 2005 the highest yield has been reached by variety *Liseta* but in 2004 it had reached her maximum in dry matter weight up to 23,3 % DM and raw ashes 6,65 %. In 2005 variety *Cleopatra* has also reached high percentage of dry matter 20,5% DM and 5,46% of raw ashes. The important thing is that the highest yield for both years has been obtained with application of 300 kg N/ha (graph 1.). Pearson's correlation coefficient revealed significance to  $P<0.01$  in correlation occurred between percentage of nitrogen and treatments for first year while in the second year

significance is at level of  $P < 0,05$ . Strong correlation has occurred between percentage of nitrogen and percentage of dry matter weight of yield for both years; - for 2004 it is  $r = 0,451^{**}$ ; - and for 2005 is  $r = 0,707^{**}$  (graph 2). The studies have showed that there was a high correlation level between nitrogen concentration, the rate of nitrogen fertilization and yield of dry biomass in all vegetative phases and this is also connected with influence of soil supply and metrological condition (12). Results show that for both years correlation coefficient stays high between number of haulms per plant and density of plant sites per treatment up to  $r = 0,807^{**}$  and  $r = 0,608^{**}$  (graph 3.). Thus, correlation has also occurred between density of plant sites and biomass of potato crop at  $r = 0,36^*$  for the first year (graph 4) and for the second year (graph 5), number of haulms per plant and biomass of plant per treatment shown correlation at level  $r = 0,36^*$ . Also, it is obviously from table 1. that the percentage of nitrogen of potato tuber grows with increments of nutrition treatments in compare with control treatment. Besides, we showed that increasing fertilization doses affects at some quantitative characteristic of potato crop as well as at increments of total yield production.

Graph 1. Potato tuber yield in kg/plant per treatments for 2004 and 2005 year



## CONCLUSION

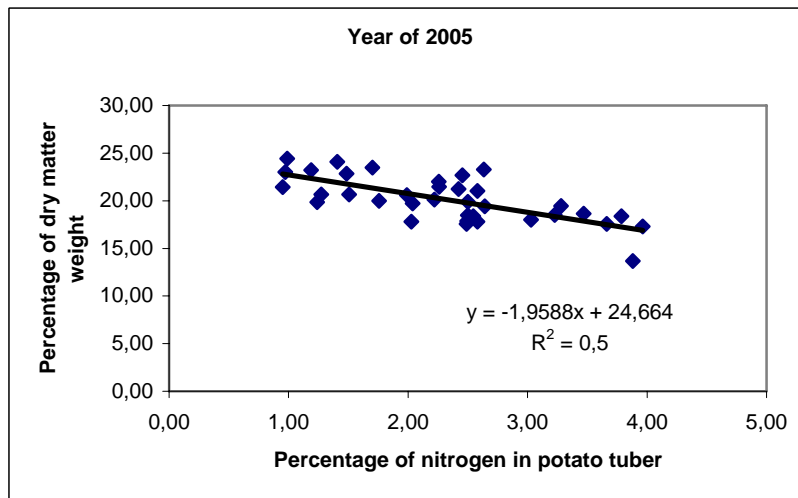
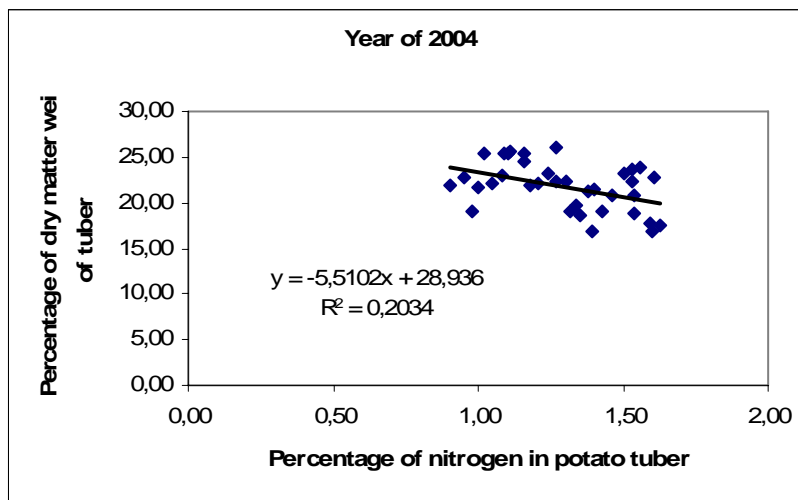
Increasing nitrogen fertilizer doses results in increments of potato yield in this field experiment. It also affects on increment of few quantitative traits collected during this research. We have also obtained a good respond of potato varieties at split nitrogen application.

## REFERENCES

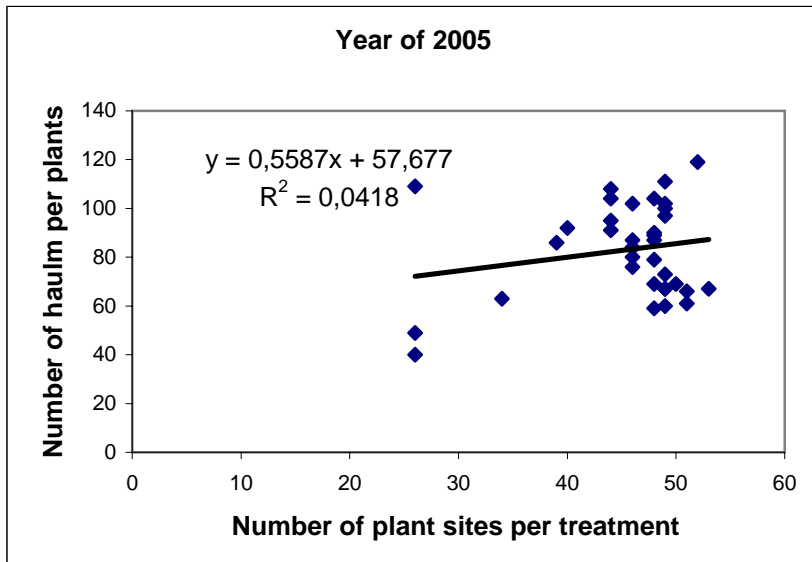
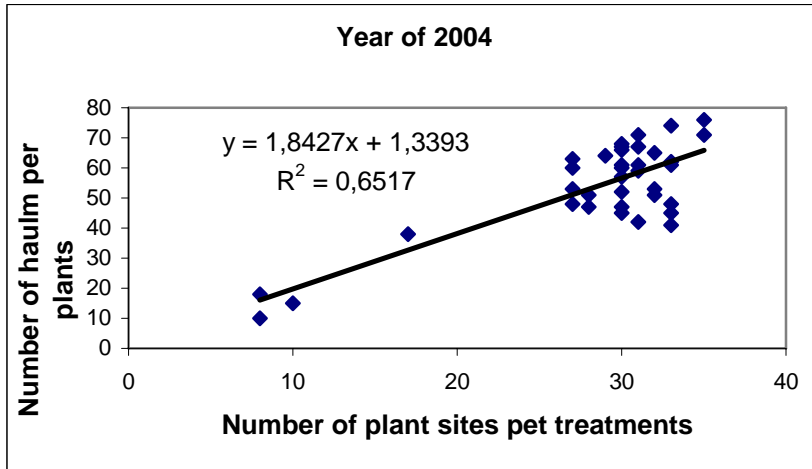
1. Association of Official Analytical Chemists. 1995. Official methods of analysis of the Association of Official Analytical Chemists. AOAC, Washington, DC. C. 34, p. 8.
2. A. Delden, 2001, Yield and Growth Components of Potato and Wheat under Organic Nitrogen Management, *Agronomy Journal*. v. 93, 1370-1385.
3. F., Fritsch, B., Roberts, B., Travis, W., Rain, R., Hutmacher, 2003. Response of Irrigated Acala and Prima Cotton to Nitrogen fertilization, *Agronomy Journal*. 95: 133-146.
4. N. K., Fageria, V.C Baligar and C.A. Jones, 1997, Growth and mineral nutrition of field crops. Ed. By R.R Bowker. Marcel Dekker Inc. USA. Chapter 1. pp. 1-11
5. I., Kádár, 1992, Principles and methods of Plant Nutrition. RISSAC-HAC, Budapest, Chapter 4 and 10, pp. 55-100; 334-370
6. H., Marschner, 1995, Mineral nutrition of Higher Plants, Second edition. Academic Press, London, New York, Boston, Tokyo, Toronto.
7. Millard P, and B Marshall. 1986. Growth, nitrogen uptake and partitioning within the potato (*Solanum tuberosum* L.) crop, in relation to nitrogen application. *J Agric Sci Camb* 107:421-429.
8. I., Morena de la, A., Guillen, L. F. G., Moral, 1944, Yield development in potatoes as influenced by cultivar and the timing and level of nitrogen fertilization. *American Potato Journal*, Orono, v.71, p.165-173
9. M., Poljak, M., Herak-Ćustić, T., Horvat, L., Čoga, A., Majić, 2007, Effects of nitrogen nutrition on potato tuber composition and yield. // *Cereal Research Communications*. v.35, Part 2; 937-940
10. SPSS. SPSS for Windows v. 13.0. SPSS Inc., 2004.
11. P. C., Struick, A. J. Haverkort, D., Vreugdenhil, C. B., Bus, R., Dankert, 1990, Manipulation of tuber-size distribution of a potato crop. *Potato Research*, Wageningen, v.33, p.417-432
12. E., Tosheva, P., Alexandrova, 2006, Relationship between nitrogen regime, plant nitrogen concentrations and yield biomass in wheat; 41<sup>st</sup> Croatian and 1<sup>st</sup> international symposium on Agriculture; Opatija, Preceedings, pp.501-502

Attachment

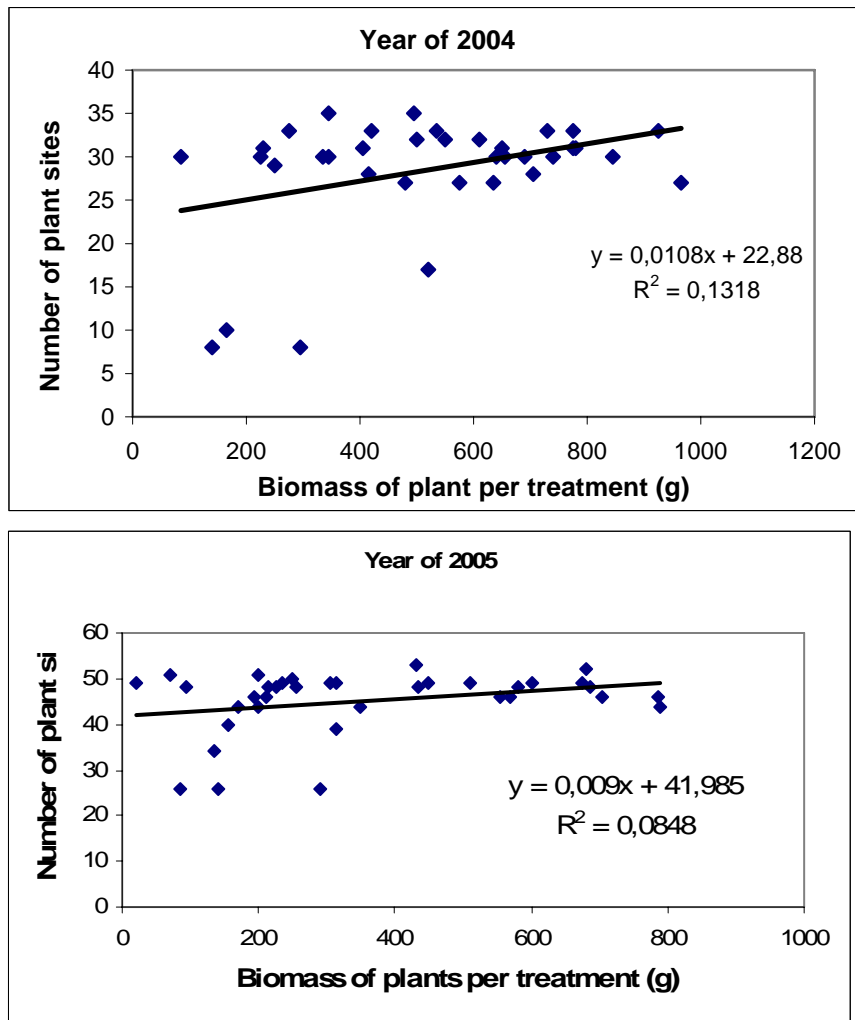
Graph 2. Correlation relationship in 2004 and 2005 year between percentage of dry matter weight and percentage nitrogen in potato tuber



Graph 3. Correlation relationship in 2004 and 2005 year between number of plant sites per treatments and haulms per plants



Graph 4. Correlation relationship in 2004 and 2005 year between number of plant sites per treatments and biomass of plants





Graph 5. Correlation relationship in 2004 and 2005 year between number of haulm per plant and biomass of plants per treatments

