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Effect of Chicken Manure and Organic Nitrogen Levels on Yielding and Antioxidant Content of Tuber Potato at Algeria Sahara

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***Abstract* – A field study was carried out to determine the impact of organic manure and the level of nitrogen fertilizer on vegetative growth, plant height, leaf area, plant cover, tuber number and weight, tubers contents of proteins, polyphenols and flavonoids of the potato variety Spunta. The quantity of fertilizer applied was based on 50 tons/ha with Protifert rates (1, 2, 3 kg / h). The results show that a significant difference for all the studied traits of the vegetation period of all the treatments. Plant height, leaf area, plant cover, stems number and the numbers of tubers were linearly increased and very significant in the application (50 tons of chicken manure + 3 kg / h Protifert). Weight maximum of tubers (209.87g) was obtained using 50 tons (chicken manure + 3 kg / h Protifert). The richest of proteins has been recorded in the treatment (50 t / h chicken manure + 3 kg / h Protifert) (NPK 2QU / h 25 t / h of chicken manure) and (50t / h chicken manure + 1 kg / h Protifert).**

The phenolic and flavonoid content were greater in treatments (NPK 2QU / h to 25 t / h chicken manure) (50t / h chicken manure + 2 kg / h Protifert) and (50t / h chicken manure + 3 kg / h Protifert). Organic manure and the level of nitrogen fertilizer led to higher nutritional value of potato tubers left its impact on the properties of vegetative physiological proprieties of potato plants.

***Keywords* – *Solanum Tuberosum*, Manure, Protefert, Polyphenol, Flavonoid, Vegetative Growth.**

I. INTRODUCTION

Potato (*solanum tuberosum*) is one of the major corps contributing to food requirement world [1. In 160 nations around the world, it is considered the most popular salad corps [2]. Topping the list of tuber corps in terms of quantity of production, it occupies wide importance in the food program of the states [3], [4]. Currently, the potato is the fourth most important food body around the world after maize, wheat and rice [5], [6] , with a production of 364.8 million tones (FAO, 2014).

The tuber is a source of dietary starch, proteins, fiber and minerals [7], [8]. Interestingly, it is considered to be a potential source of natural antioxidant in the human diet [9], to substitute the usage of synthetic antioxidant been shown to increase the risk and liver damage in human [10], Thus, the interest in natural antioxidants has been increased considerably [11].

Current research into free radicals has confirmed that foods rich in antioxidant play an essential role in the prevention of cardiovascular diseases and cancers [12], [13] as well as neurodegenerative diseases [14].

The content of total antioxidant and nutrient influenced both by different intrinsic factors such as the biodiversity [15]. The potato biodiversity is vast, with more than 4000 known varieties of extrinsic factors such as the conditions of cultivation and growing[16], [17] , location, climatic condition year of cultivation and fertilization [18].

Fertilizer application has important effects on the growth, quality and yield of potatoes [19], [20] and antioxidant content [21] . An organic fertilizer has been proven to enhance antioxidant content in plants [22] improving physical and biological properties of soil, help in improving the efficiency of chemical fertilizers [23].Organic manure ensured sustainable soil health [24]. The results also suggest that the usage of organic manures can enhance the production of plant secondary metabolites. Nitrogen remains one of the main nutrients required for plants growth and yield [24].It has been shown that levels of fertilization of nitrogen phosphorus, potassium and calcium affect the production of secondary metabolites in plants [25], [26]. The objective of this research is to estimate the effect of different nitrogen levels on yielding and antioxidant content of potato.

II. MATERIALS AND METHODS

The experiment was conducted in the natural conditions in farm, El-oued city in Algeria, with sandy soils. The plant was cultivated in spring seasons in 2013 using plant potatoes variety *Spunta* which was taken from the production company AGRICO.

The experiment was a completely randomized design with three replicates treatment were include
T1 – No manure use (control).
T2 –NPK 2qu/h +25 t/h chicken manure.
T3 -50t/h chicken manure + 1 kg/h Protifert
T4 - 50t/h chicken manure + 2 kg/h Protifert
T5 - 50t/h chicken manure + 3 kg/h Protifert .

Plant tuber with average weight between 80-100g was planted at a 10 cmof depth and with 30 cm dimension apart in the same line and 50 cm apart in between lines.

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The irrigation was implicated every three days, while every day after the germination takes place.

The nitrogen fertilizer called (Protefert LMW) was added in 35, 60 and 75 day from the first day of planting.

A-Collection date

Growth and yield parameters were measured; Leaf area, plants height, tuber weight and yield of for five plants of each treatment of all blocks [19]. Also, the antioxidants content and protein quantity in tubers were determined.

B-Preparation of potato extracts

The tuber potatoes was peeled and then turned into thin chips and left at room temperature until gotten dried .Then crushed and screened to obtain powder tubers.

Therefore, 6 ml of methanol were added to 1 g of tuber flour. The mixture was agitated for 1h at 200rpm and steeped for16 h. The prepared suspension was filtered using Whatman No.1 filter paper. The extracts were subsequently centrifuged at 1500g for10 min at 4 °c and supernatant stored at 4 °C and used to banalyze the content of tuber and stored in a refrigeration condition [27].

C-Determination of total polyphenol

Compounds in the extracts were determined according to the method of [28], [8] using Gallic acid as a standard phenolic compound. A volume of 100 µL of the extract was mixed with 7.9 ml distilled water and 50 µL of 10-fold-diluted Folin-Ciocalteu reagent. After being agitated for some minutes, 1.5ml of 20% sodium carbonate solution was added and the mixture was allowed to stand for 2 h at room temperature. The absorbance was measured at 765 nm using a Biowaven spectrophotometer.

D-Determination of total Flavonoid

Total flavonoid content was measured using a method described by Fidrianny [29] .

E-Determination of total protein:

Protein extracted and determined was carried out according to the method described by Jose [30] ,as suggested by Snyder and Desborough [31.

III. RESULTS

A-Effect of organic nature manure in leaf area

The results (table 1) represent the development of leaf area during the growth period of potato plant, a significant difference in all the manure treatments.

A significant differences between (50t/h chicken manure + 2 kg/h Protifert, 50t/h chicken manure + 3 kg/h Protifert) and (NPK 2qu/h +25 t/h chicken manure, 50t/h chicken manure + 1 kg/h Protifert) treatment, again was remarked the area in50t/h chicken manure + 1 kg/h Protifert is more than NPK 2qu/h +25 t/h chicken manure.

In the end of first period after adding the nitrogen fertilizer represent significant differences in (50t/h chicken manure + 1 kg/h Protifert)compared with (NPK 2qu/h +25 t/h chicken manure) , no significant differences between (50t/h chicken manure + 1 kg/h Protifert) , (50t/h chicken manure + 2 kg/h Protifert) and (50t/h chicken manure + 3 kg/h Protifert). Also between NPK 2qu/h +25 t/h chicken manure,(50t/h chicken manure + 2 kg/h Protifert) and(50t/h chicken manure + 3 kg/h Protifert) treatment.

In the second period adding nitrogen fertilizer (75 days), a significant differences between (50t/h chicken manure + 1 kg/h Protifert) compared (50t/h chicken manure + 2 kg/h Protifert) and (50t/h chicken manure + 3 kg/h Protifert). Also, a significant differences between (NPK 2qu/h +25 t/h chicken manure) and (50t/h chicken manure + 2 kg/h Protifert), while no significant differences between(50t/h chicken manure + 2 kg/h Protifert) ,(50t/h chicken manure + 3 kg/h Protifert) and between (NPK 2qu/h +25 t/h chicken manure),(50t/h chicken manure + 1 kg/h Protifert).The growth speeds during this period in NPK 2qu/h +25 t/h chicken manure and(50t/h chicken manure + 1 kg/h Protifert) more than other period .

B-Effect of organic nature manure in plants height

The results showed the stem length increasing in all treatments to 75 day of planting date which was considered as the last period of vegetative growth.Table (2) shows a significant differences in all the manure treatments compared to the control in both phases(60 days and 75days after planting).

Applying the (50t/h chicken manure + 2kg/h Protifert) and the (50t/h chicken manure + 3kg/h Protifert) represented higher group than the other treatments .The (50t/h chicken manure + 1kg/h Protifert) treatment was better than the (NPK 2q/h to 25t/h of chicken manure) during the first period.

Furthermore, comparison of means (Table 2) during the second period showed that all manure treatments were classified in the same group and had no significant differences in the average height of the plant,

C-Effect of organic nature manure in Vegetation Cover

The vegetation cover in the first measure is superior in t5 (134.66) and is inferior in control treatment (52.94) represented in table3. In second measure the cover is more increased in50t/h chicken manure + 1 kg/h Protifert while is little growing in control. The results represent significant differences of (50t/h chicken manure + 1 kg/h Protifert, 50t/h chicken manure + 2 kg/h Protifert) compared to other treatment .The third measure showed a great growth in t3 than t5 and lower in control.

No significant differences between NPK 2qu/h +25 t/h chicken manure,50t/h chicken manure + 2 kg/h Protifert and 50t/h chicken manure + 3 kg/h Protifert treatments with a significant differences of 50t/h chicken manure + 1 kg/h Protifert compared with NPK 2qu/h +25 t/h chicken manure.

D-Effect of organic manure on the stemsnumber, tuber number and tuber weight

a- the number stem :

The results (table04) showed an increasing of the stems number in all manure treatments as compared with the control. The stems number of the third treatment represents significant differences compared with other treatments.

b- the tuber number and weight

We show an increasing in the tuber number and tuber weight in all treatments compared with the control. with a considerable increasing of the tuber number in NPK 2qu/h +25 t/h chicken manure, 50t/h chicken manure + 1

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kg/h Protifert followed by (50t/h chicken manure + 2 kg/h Protifert) and (50t/h chicken manure + 3 kg/h Protifert) respectively (table 4) and with a considerable increasing(twice) of the tuber weight in 50t/h chicken manure + 3 kg/h Protifert, 50t/h chicken manure + 2 kg/h Protifert followed by 50t/h chicken manure + 2 kg/h Protifert and 50t/h chicken manure +3 kg/h Protifert respectively (table 4). The result of all manure treatments represent a significant differences compared with the control.

E-Effect of organic manure and nitrogen level in tuber content

a- Protein

The results (Tables 5) show the effect of five treatments on some nutritional characteristics of tuber potatoes Spunta cultivars. The lowest protein content recorded in (50t/h chicken manure + 2 kg/h Protifert) treatment; whereas ,the highest in (50t/h chicken manure + 3 kg/h Protifert),(NPK 2qu/h +25 t/h chicken manure) and (50t/h chicken manure + 1 kg/h Protifert) treatment. However, commented in (50t/h chicken manure + 3 kg/h Protifert) treatment a significant difference compared with the control while in the other there was no significant difference.

b- Polyphenol and flavonoid

We observed a slight increase in the content of polyphenols and flavonoids in any treatment compared to the control with more increasing in (50t/h chicken manure +3 kg/h Protifert), (NPK 2qu/h +25 t/h chicken manure), (50t/h chicken manure + 1 kg/h Protifert) and (50t/h chicken manure + 2 kg/h Protifert), respectively (Table 5).

IV. Discussion

The vegetative growth of potato plant improved with different manure treatments incorporated into the soils. Similar patterns improving vegetative growth has been reported for other crops such as [31]- [34].

Potato plant takes up large amounts of organic manures which are valuable as sources of many fertilizers and essential macro and micronutrients to plants, lower leaching of N due to possible improved soil texture. Structure conditioner being rich in organic matter and increase availability can increase the uptake of nitrogen, phosphorus and potassium[35].This increase has a positive effect on the chlorophyll concentration, the photosynthetic rates, metabolic processes of organic compounds in plant, cell elongation and division [36]- [40]. Thus, lead to significant increases on plant height, root system, the leaf expansion, the total number of leaves and the dry matter accumulation. Consequently Nitrogen fertilizer plays an important role in canopy development especially on the shoots matter, total tuber yield and their high content of protein [41], [36].

A potato is considered as a good source of antioxidants, including polyphenols, flavonoids and vitamins, designating their importance as a vegetable food [42], [43]. Comparing the obtained results reveal a slightly increase in the content of polyphenols and flavonoids in any treatment compared to the control. The availability of essential macronutrients in the growth of the plants has a significant potential to affect the accumulation of polyphenols.

In research these differences may be influenced by several factors, such variety, the color of tubers and tuber maturity [43]- [45]. So, it was found that the content of total polyphenols higher in immature tubers and decreases with mature tubers.

Although, it has been shown that levels of fertilization of nitrogen and organic manure effect on the production of secondary metabolites in plants [25], [26].

V. Conclusion

The nutritive value of potatoes is largely dependent on fertilizer treatments. Fertilization is the most important and controllable factor affecting nutritional value of vegetables.Plant growth of potatoes, development of tubers and their content was affected by organic manure with level of nitrogen application. Also, it is clear that the nitrogen fertilizers use of organic manure have a positive effect on the production of antioxidants, polyphenols

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Table 1: Effect of organic manure and nitrogen level on the leaves area

Treatment	Leaf area		
	35 days after planting	**60** days after planting	**75** days after planting
T1	20.42	42.63	88.06
T2	31.74	105.31	205.46
T3	35.06	127.66	215.01
T4	39.5	113.83	177.53
T5	38.53	113.03	187.07
LSD	6.73	18.1	25.88

Table 2: Effect of organic manure and nitrogen level on Plant height

Treatment	Plant height		
	35 days after planting	**60** days after planting	**75** days after planting
T1	3.06	6.47	14.88
T2	3.34	20.3	51.9
T3	4	24.6	59.05
T4	3.13	27.3	57.85
T5	4.16	27.32	57.35
LSD	0.72	4.48	9.2

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Table 3: Effect of organic manure and nitrogen level in vegetation cover

Treatment	Vegetation Cover cm^2		
	35 days after planting	**60** days after planting	**75** days after planting
T1	52.94	244.5	463
T2	83.33	1134.5	2356.7
T3	102.66	1573.4	3816.3
T4	124.83	1516.5	3161.4
T5	134.66	1133.3	3375.1
LSD	20.56	360.3	736.4

Table 4: Effect of organic manure and nitrogen level on stem number, tuber number and tuber weight

Treatment	stems number / plant	tubers number/ plant	tuber weight
T1	1.5	1.65	98.43
T2	1.9	6.3	161.44
T3	4.5	6.05	170.32
T4	2.5	5.35	184.76
T5	2.1	4.7	209.87
LSD	2.13	1.58	62.2

Table 5: Effect of organic manure and nitrogen level on the tuber content

Treatment	Protein	Polyphenol mg catechin·g-1	Flavonoid
T1	69.31	2.04	0.57
T2	85.98	2.45	0.66
T3	84.2	2.25	0.60
T4	77.18	2.44	0.65
T5	90.39	2.46	0.69
LSD	18.51	1.29	0.34

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