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Investigating features of Potato (*Solanum tuberosum.* var Mafrona) under usage of Biologic Manures Super Nitro plus & Humic Acid[1]

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To investigate the effect of biologic manures Super Nitro plus & Humic acid on quantitative & qualitative features of *Solanum tuberosum* var Mafrona , the test has been done as Factorial in the form of completely random block design with 3 replication in Dasht-e-Mir Farm sited 20 km far from Khodabandeh city with 36,03 longitude and 49,22 latitude during crop year 2014-15. Treatments include 3 levels of Humic acid 0, 2, 4 (Liters per hectare) as foliar application after weeding bush & super Nitro plus in 3 levels 0, 2, 4 (Liters per hectare) as tuber impregnating with manure solution has been done. Results have indicated that Humic acid effect on studied features has been significant in (P<0.01) level and the highest yield and percentage of tuber dry matter from 4 (L/ha) treatment has been obtained 31120(kg/ha) and 19.08(j), respectively. In investigating the interaction of Super Nitro plus and Humic acid in yield per unit area; 4 (L) biologic manure and 4 (L) Humic acid with 31740(kg/ha) value had the highest yield; also, the highest percentage of tuber dry matter has been obtained from 4 (L) Super Nitro plus treatment and 4 (L) Humic acid with 19.36 (j) value which is at the same statistical group with 2 (L) biologic manure and 4 (L) Humic acid with 19.13(j). Also, the highest percentage of Crude Protein (CP) has been obtained from 4 (L) Super Nitro plus treatment and 4 (L) Humic acid with 8.70 (j). the highest value of auxin hormone has been obtained from 2 (L) Humic acid treatment and 4 (L) biologic manure with 311.9 Micromole/g value.

Key words: Potato, biologic manure, Humic acid , IAA & Marfona.

Potato (*Solanum tuberosum*) is one of important glandular crops which have a main and important role in world people nutrition and agricultural economy[1]. Potato is planted in most of world regions in range of 65 ° N to 45 ° S latitude and to a height of over 3500 meters from the sea level[2]. Farmers try to make closer crop production to genetic power through resolving food deficiency & using proper management operation[3].Published Statistics by FAO[4] (Food and Agriculture Organization) always indicate under plant growing trend and yield of this crop in Iran.

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While plant grows in abnormal circumstances such as over-consumption of nitrogen manure; protein production decreases and nitrogen accumulate as non-protein form in the plant. Nitrate is one of the non-protein forms which its over-consumption will cause to toxicity in food chain[5]. So, necessity of using different manure sources is increasing every day. One of the most important manure in consumption part of plant is Humic acid. Humic acid is a natural polymer related to +H acidic agents which has phenolic and benzoic Carboxyl positions (cation exchange locations). Humic acid can effect directly on plant growth[6] have investigated the effect of humic acid on some grass. They have found that usage of humic acid result in increment of pasture plant shoot[7] have investigated effect of humic acid on corn growth

in calcareous soils in a greenhouse research. Their results have indicated that different dose of humic acid foliar application has different and significant effect on total dry weight value of plant and humic acid has positive and significant effect on absorption of Copper, Zinc, Manganese, Phosphorus, and Sodium in dose 0.01.

In[8] research, different effects of humic acid on wheat have been investigated. Their results have investigated that different level of humic acid has different significances among stem weigh, height plant and value of nitrogen absorption in wheat growth.

Bulent Asik *et.al* (2012)[9] have investigated effect of humic acid on type of *Triticum durum* Salihli .Their results have indicated that humic acid cause to increment in absorption of Phosphorus, Potassium, Magnesium, Sodium, Copper & Zinc.

Usage of humic acid in the form of foliar application and soil in plant will cause to increment in Auxin, Cytokinin & Gibberllins hormones[10]. In a research[11], have investigated effect of humic acid on corn. Results of their investigation have indicated that humic acid can have very positive effect on plant physiology. Abu-aly & Mady[12] have reported that humic aid usage through shoot in wheat plant have caused to 3.1 % auxin increment in shoot at 80 days after planting in two growing seasons.

Some of existent microorganisms in rhizosphere cause to physiologic and morphologic changes in plants due to different mechanisms; this series of changes affect plant growth, nutrition and health. Term "PGPR (Plant Growth Promoting Rhizobacteria)" has been presented at first by Kloeper , et al(13). Main plant growth motive bacteria which their applications in recent researches have been considered are related to *azotobacter*, *azospirillum*, *pseudomonas* & *Bacillus*. Although, quality of plant relation and plant growth motive through this bacteria is not clarified completely; but their beneficial effects can be resulted from factors such as; antibiotics synthesis, siderophores, plant hormones, N2 biological consolidation , reduction in membranes electrical potential, production of some kind of enzymes such as ; Acc deaminase and increment in availability to nutrient elements (14). Piao et.al (15) have reported that due to inoculation of PGPRs, rice yield has increased in comparison to control group and inoculation of each strain . In fact, biologic manures are materials include different kind of free living microorganisms[16-17] , have the ability of converting main nutrient elements from unavailable form throughout biological processes[16 ; 18] and result in root system advancement and seed better germination[17 ; 19]. Also, significance increment in seed yield and nitrogen accumulation in rice seed have been seen through insemination strain of *Azospirillum amazonense with* this plant[20]. It has been reported that *Azospirillum* bacteria not only produces growth motive hormones such as auxin and gibberellin but also releases hormones such as ABA (Abscisic acid) in tension (stress) condition on order to decrease tension effect in the plant ; in fact , this bacteria cause to yield increment through growth promotion and tension decrement[21-22]. Also, Patten[23] has reported increment in auxin production through *Pseudomonas* bacteria. Raja[24] has investigated hormonic changes by *Pseudomonas* & *Azospirillum* insemination through a research on rice seedling and has observed 9.6 & 7.4 times auxin value in comparison to control treatment. Super Nitro plus manure include *Bacillus subtilis, Pseudomonas fluorescens* and *Azospirillum* spp. This biologic manure contains 10^8 bacteria per milliliter.

MATERIALS AND METHODS

This research has been done as Factorial in the form of completely random block design with 3 repeat in Dash Mir Farm sited 20 km far from Khodabandeh city with 36,03 longitude &49,22 latitude during the crop year 2014-15. Treatments plots include 3 levels of Humic acid (0, 2, 4 & Liters per hectare) as foliar application after weeding bush and super Nitro plus in 3 levels (0, 2, 4 Liters per hectare) as tuber impregnating with manure solution has been done. Super Nitro plus manure include *Bacillus subtilis, Pseudomonas, fluorescens* and *Azospirillum* spp. This biologic manure contains bacteria per milliliter. In each treatment plot, 5 plants row with 75 centimeter distance and bushes with 20 centimeter distance have been determined. Planting has been done on May 20 and combating to weeds has been done manually. Tubers have been harvested at the end of September and tuber

length features , yield per plant , shoot dry weight, average yield,tuber dry matter percent and crude protein percent as well as auxin hormone has been measured. Shenji *et.al*.,[25] method has been used to isolate auxin hormone. To determine auxin hormone density has been used of HPLC tool model Unican. Obtained data by MS tat-c program have been evaluated.

RESULTS AND DISCUSSION

Investigating effect of humic acid on tuber length, yield per plant, total dry weight of shoot, average yield, dry matter percent and crude protein percent has become significant in (P<0.01). The highest average yield per plant has been obtained from 4 (L) humic acid treatment with value of 578.3(g) and has been placed in first statistical group. Also, the highest average yield has been obtained from 4 (L) humic acid treatment with value of 31120 (kg/ha). The least average yield has been obtained from control treatment with value of 25960 (kg/ha). Investigating effect of humic acid on dry matter percent has become significant in (P<0.01). The total dry weight of shoot has been obtained from 4 (L) with value of 88.46 (g). The dry matrer percent has been obtained from 4 (L) humic acid treatment. It seems that humic acid consumption cause to increment in absorption plant needed elements which it will increase tuber dry matter. (9) have investigated effect of humic acid on a kind of *Triticum durum* Salihli. Their results have indicated that humic acid cause to increment in absorption of Phosphorus, Potassium, Magnesium, Sodium, Copper and Zinc. Usage of humic acid in the form of foliar application and soil in plant will cause to increment in Auxin, Cytokinin and Gibberllins hormones in plant(10). Humic acid causes to increment in plant photosynthesis activity through increment in rubisco enzyme activity (26) (Table 1).

Effect of humic acid on cride protein percent has become significant in (P<0.01) . highest and its value is related to 4 (L) humic acid treatment with value of 8.18 (%) which has been placed at the same statistical group with 2 (L) treatment with value of 8.09(%).Effect of humic acid on auxin hormone has become significant in (P<0.01). The highest value of this hormone has been obtained from 2 (L) humic acid treatment with value of 285.7 (µ mol/ g) which has been placed at the same statistical group with 2 (L) treatment with value of 282.3(µ mol/ g) (Table 1).

Effect of Super Nitro plus (SNP) hasn't become significant on tuber length and yield per plant. The highest tuber length has been obtained from 2 (L) (SNP) with value of 5.5 (cm) which has been placed at the same statistical group with 4 (L) (SNP) with value of 5.48 (cm).Effect of (SNP) treatment on average yield has become significant in (P<0.05). Results have indicated that the highest average yield has been obtained from 4 (L) (SNP) treatment which has been at the same statistical group with 2 (L) and control treatment with value of 29420, 28539 & 28420 (kg/ha) respectively. PGPRs can directly and indirectly affect on plant growth which this increment can be done for plant through different mechanisms such as ; nitrogen supplying for plant through N2 consolidation, producing growth motive materials like Auxin, Cytokinin and Gibberllins, creating biologic control against soil pathogens (27) and preventing Ethylene production , solving inorganic Phosphorus and mineralizing organic Phosphorus(28) as well as making accessible other nutrition for plant. (29). Also , there is numerous reports on effect of *Azotobacter chroococcum* and *Azospirillum*. *brasilense* strains on yield of different plants which indicate that these bacterium will cause to increment in nitrogen consolidation , increment in absorption of elements such as ; Phosphorus, Potassium and Iron as well as plant water status improvement and production of Phytohormones in this plant (30)(Table 2).

Effects of (SNP) on total dry weight of shoot, dry matter percent and crude protein percent of tuber have become significant in (P<0.01). The total dry weight of shoot has been obtained from 4 (L) (SNP) treatment with value of 96.15(g). Also, the highest dry matter percent of tuber has been obtained from 4 (L) (SNP) treatment with value of 18.56(%) which has been at the same statistical group with 2 (L) and control treatment with value of 18.37 and 18.25 (%) respectively.the highest crude protein percent of tuber has been obtained from 4 (L) (SNP) treatment with value of 8.48(%) has been placed in first statistical group. Single & double inoculation of nitrogen consolidation bacteria and Phosphorous solving bacteria has significantly increased content of pea seed in

comparison to control treatment and this increment has been equal to or more than P, N & NP manure treatment[31]. Effect of (SNP) on auxin hormone has been significant in (P<0.01). The highest of this hormone has been obtained from 4 (L) (SNP) treatment with value of 303.4 (µ mol/ g) which has been placed at the same statistical group with 2 (L) treatment with value of 300.4 (µ mol/ g) (Table2).

Interaction of humic acid and (SNP) consumption on tuber length has become significant in (P<0.05). The highest tuber length has been obtained from 4 (L) humic acid treatment

Table 1. Means comparison for effects of humic acid levels on different traits in potato (*Solanum tuberosum* var. marfona)

Humic acid (L/ha)	Tuber length (cm)	Yield per plant (g)	average yield (kg/ha)	Total dry weight of shoot (g)	Tuber dry matter percent (j)	Crude Protein percent (j)	IAA (µ mol/ g)
control	4.97 b	455.3 c	25960 c	82.77b	17.67 c	7.89 b	266.9 b
2	5.53 a	495.7 b	28150 b	80.16 b	18.43 b	8.09 a	285.7 a
4	5.73 a	578.3 a	31120 a	88.46 a	19.08 a	8.18 a	282.3 a
duncan	**	**	**	**	**	**	**

Comparison with the Duncan test (P<0.05). ns: no significant * and **: Significant at 5% and 1% levels.

Table 2. Means comparison for effects of super nitro plus levels on different traits in potato (*Solanum tuberosum* var. marfona)

Super nitro plus (L/ha)	Tuber length (cm)	Yield per plant (g)	average yield (kg/ha)	Total dry weight of shoot (g)	Tuber dry matter percent (j)	Crude Protein percent (j)	IAA (µ mol/ g)
control	5.24 b	512.6 a	28420 a	67.47 c	18.25 a	7.69 c	231.2 b
2	5.50 a	499.9 a	28536 a	87.78 b	18.37 a	8.00 b	300.4 a
4	5.48 a	516.8 a	29420 a	96.15 a	18.56 a	8.48 a	303.4 a
duncan	ns	ns	*	**	**	**	**

Comparison with the Duncan test (P<0.05). ns: no significant * and **: Significant at 5% and 1% levels.

Table 3. Compared average to the interaction of Humic acid and super nitro plus on different traits in potato var.marfona

interaction of Humic acid and super nitro plus	Tuber length (cm)	Yield per plant (g)	average yield (kg/ha)	Total dry weight of shoot (g)	Tuber dry matter percent (j)	Crude Protein percent (j)	IAA (µ mol/ g)
0 * 0	4.44 d	411.1 c	25390 d	63.94 f	16.94 d	7.13 g	223.3 d
2 * 0	5.28 bc	484.0 b	26400 cd	70.02 e	17.25 dc	8.09 d	286.2 b
4 * 0	5.19 c	470.8 b	26932 c	68.45 ef	17.83 c	7.84 ef	291.1 b
0 * 2	5.61 abc	498.7 b	27265 bcd	87.43 c	18.67 abc	8.20 cd	235.6 c
2 * 2	5.48 abc	447.0 bc	27560 bcd	81.33 d	18.12 bc	7.79 f	309.8 a
4 * 2	5.49 abc	481.3 b	26971 cd	94.59 b	18.50 abc	8.01 de	311.9 a
0 * 4	5.68 ab	579.9 a	27340 bcd	89.14 c	18.75 ab	8.34 bc	234.7 c
2 * 4	5.73 ab	568.7 a	25390 b	96.95 b	19.13 a	8.40 b	305.1 a
4 * 4	5.78 a	586.3 a	31740 a	102.3 a	19.36 a	8.70 a	307.2 a
duncan	*	**	**	**	**	*	ns

Comparison with the Duncan test (P<0.05). ns: no significant * and **: Significant at 5% and 1% levels.

and 4 (L) (SNP) with value of 5.78 (cm). Interaction of humic acid and (SNP) consumption on yield per plant, yield average, total dry weight of shoot and dry matter percent has become significant in ($P<0.01$). The highest yield per plant has been obtained from 4 (L) humic acid and 4 (L) (SNP) with value of 586.3 (g) which has been placed at the same statistical group with 4 (L) humic acid and 2 (L) (SNP) and 4 (L) humic acid without bacteria with value of 567.8 and 579.9 g, respectively. Also, the highest average yield has been obtained from 4 (L) humic acid treatment and 4 (L) (SNP) with value of 31740 (kg/ha). The least average yield has been obtained from control treatment with value of 25390 (kg/ha) (Table 3).

The highest total dry weight of shoot has been obtained from 4 (L) humic acid treatment and 4 (L) (SNP) with value of 102.3 (g). The dry matrer percent of tuber has been obtained from 4 (L) humic acid treatment and 4 (L) (SNP) with value of 19.36(%)which has been placed at the same statistical group with 4 (L) humic acid treatment and 2 (L) (SNP) with value of 19.13(%). The highest crude protein percent has been obtained 4 (L) humic acid treatment and 4 (L) (SNP) with value of 8.70 (%). Interaction of (SNP) and humic acid on auxin hormone has not been significant. The highest of this hormone has been obtained from 2 (L) humic acid treatment and 2 (L) (SNP) with value of 311.9 (µ mol/ g) which has been placed at the same statistical group with 2 (L) humic acid treatment and 2 (L) (SNP), 4 (L) humic acid treatment and 2 (L) (SNP) and 4 (L) humic acid treatment and 4 (L) (SNP) with value of 309.8, 305.1 & 307.4 (µ mol/ g), respectively. (Table3).

CONCLUSION

Considering people increment and need to more food as well as necessity of using healthier food, using alternative and less dangerous manures for individual and environment health is becoming more important and remarkable gradually. Therefore, using materials such as; humic acid and biologic manure can be a useful way to achieve to these objectives and producing healthier crops. In this research, it has been clarified that we can introduce alternative manures to prevent usage of chemical manures although we are force to use chemical manures due to soil weakness in terms of organic and nutrients.

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