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Research Article

EFFECT OF CHEMICAL, BIOLOGICAL AND NITROGENOUS ORGANIC FERTILIZERS ON SOME AGRONOMIC TRAITS AND YIELD OF POTATO (AGRIA VARIETY)

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ABSTRACT
To evaluate the effect of chemical, biological and nitrogenous organic fertilizers on some agronomic traits and yield of potato (Agria variety); the experiment was performed in cropping season of 2012-2013 at Sharabiyan city located in Mehreban of Sarab county. The trial was conducted in form of split plot based on randomized complete block design with three replications. This experiment was carried out with 3 factors which were included: usage of urea chemical fertilizer as the main factor in 5 levels: (control: without using urea, 25, 50, 75 and 100% of recommended amount based on soil test); consumption of Nitroxin biological fertilizer as subordinate factor in 2 levels: (rubbed tuber with 10 and 20 liters per hectare) and consumption of avian enriched organic manure (Maghafer) as sub-subordinate factor in 2 levels (soil usage before planting at rates of 1500kg and 1800kg per hectare). In this study, tuber weight per plant, weight of tuber smaller than 35 mm, between 35- 55 mm and larger than 55 mm, yield of marketable tubers per area unit and tuber yield per area unit were evaluated. The results demonstrated that there were significant differences for all studied traits at interaction of Maghafer manure× chemical fertilizer levels and three-way interaction of urea chemical fertilizer× levels of Nitroxin biological fertilizer× levels of Maghafer manure. Yield of marketable tuber and tuber yield with consumption of 10 liters Nitroxin fertilizer increased about 0.45% and 0.22%, respectively; in comparison with 20 liters. Yield of marketable tuber and tuber yield in 75% recommended amount of urea chemical fertilizer based on soil test indicated augmentation about 5.58% and 4.92%, respectively; in comparison with control treatment. Amount of marketable tuber yield and tuber yield in $A_1B_1C_1$ compound as compared with $A_4B_1C_2$ compound were more about 8.32% and 6.42%, respectively.

Keywords: *Solanum Tuberosum, Biological Fertilizer, Nitrogen, Nitroxin, Avian Manure, Tuber Yield*

INTRODUCTION

Potato is belonged to *Solanum* genus and *Solanaceae* family. Agronomic potato is from *Solanum tuberosum* species and auto-tetraploid with genomic formula of 2n=2x=48. This is the only tumorous species of *Solanum* genus which is cultivated outside of its native region (Arzani, 1387). Potato is from flowering higher plants, dicotyledon class, *Solanaceae* family and *Solanum* genus which is cultivated to use its underground tuber (Rezai and Soltani, 1380). Potato is valuable foodstuff which is regarded as one of the important crops. This crop has high nutritious value due to presence of starch and essential amino acids; particularly vitamins B and C which are necessity for humans (Hassanpanah *et al*., 1387). From the view point of potato production, Iran has 12th rank in the world and is the third-largest producer in Asia after China and India (FAO, 2011). This crop is particularly important for developing countries because of its high potential per area unit and per time unit and has more nutritional value in order to maintain of growing population with malnutrition and hunger in the world (Rezai and Soltani, 1380). Its annual production in Iran with more than 4.5 million tons is in third rank after wheat and rice (Hassanpanah *et al*., 1383). In the past few decades especially in the last half century, due to population growth and demand augmentation for supplying food; chemical fertilizers have been overused in several regions to reach maximum production per area unit. Of course, it makes numerous problems in human health and environmental pollution (Qoshchi *et al*., 1385). Application of biological fertilizers have positive effects on all soil properties, in addition; it became appropriate from the view point of economic, environmental and social thus it can be used as desirable substitute for chemical fertilizers (Kuchaki *et al*., 1379). Selection of fertilizer management depends significantly on environmental programs for prevention of pollution in land and weather, therefore appropriate system of fertilizer management is worthy to expansion (Karmaka *et al*., 2007).

Application of organic matter in form of manure increases levels of soil organic carbon and have direct and indirect effects on properties and processes of soil (Paraksh *et al*., 2007). Overuse of chemical fertilizers is one of the important challenges for agriculture. Consequence of overuse in phosphate fertilizers is excessive accumulation of phosphorus; in addition, it caused to create competition in absorption of nutritious elements especially zinc (Zn), resources dissipation, decrement in population of mycorrhiza fungi and also more important of all, excessive accumulation of cadmium in crops. Thus with excessive consumption of phosphate fertilizers, toxic elements like cadmium absorb by plants and enter to food chain of humans and animals. Use of biological fertilizers with reduction in consumption of chemical fertilizers and also decrement in production costs and environmental pollution due to use of chemical fertilizers, is one of the main strategies for achievement to sustainable agriculture (Bayburdi and Malakuti, 1380). Appropriate and ideal conditions for plant growth are provided with use of chemical and biological fertilizers in form of integrative.

So that, not only there is no antagonism effect between them, but are complementary to each other. Organic fertilizers with humus production decline the harmful effects of chemical fertilizers and increase fertilizer use efficiency. Biological fertilizers with increment in activity of plant growth increaser bacterial augment effects of chemical and organic fertilizers in agricultural production (Zahang *et al*., 1998; Shata *et al*., 2007).

In a survey conducted by Eyvazlu *et al*., (2009) the effect of earthing up and barvar-2-phosphate as biological fertilizer with foliar application of micronutrients on potato yield, demonstrated that the highest yield of tuber was obtained in twice earthing up with use of barvar-2-phosphate and foliar application of ferrous sulfate. Ghobadi *et al*., (2011) in assessment of phosphate fertilizers impact on yield and yield components of potatoes indicated that simultaneous application of phosphate solvent bacteria and inorganic phosphates was effective on availability and solubility of phosphorus on soil. During investigations by Soug *et al*., (2010), it was observed that use of organic and inorganic fertilizers caused significant differences on eggplant growth, yield and fruit quality in comparison with other treatments.

Namur *et al*., (2012) in effect evaluation of nitrogen fertilizer and biological manure on yield, grain yield components and oil of sunflower, declared that the highest level of nitrogen fertilizer and inoculated biological fertilizer caused to the maximum plant height, stem, head diameter, number of grains per head, 1000-gains weight. Dadashzadeh *et al*., (2013) reported that the control treatment (no Nitroxin biological fertilizer) in comparison with treatments of fertilizer consumption had lower plant height, number of main stems per plant, number of tubers per plant and dry matter percentage. Treatment of rubbed tuber with 20 liters per hectare as compared with 10 liters per hectare had lower stem diameter, weight of tubers per plant and tuber nitrate. The purpose of this study was to evaluate the effect of organic and nitrogenous biological fertilizers at different rates and reduced nitrogenous fertilizer on tuber yield of potato Agria variety.

MATERIALS AND METHODS

This research was performed in cropping years of 2012-2013 at Sharabiyan city located in Mehreban of Sarab County in the field with area of 1200 square meters. Sarab desert was located in East Azarbaijan province and Sarab County, between two mountains of Sabalan and Bozgoush at longitude of 47˚32′, latitude of 37 ˚56 ′ and 1682 meters height from sea level (Table 1). Soil texture was sandy - loamy and surface soil had 40% rock or gravel, 46% silt and 36% clay. Pen trance of these soils was quick and its drainage was natural and perfect (Table 2). Agria variety was used in this study which is modified with intercross between Kovarta×Samlov and has received certificate No. 4577 in year 1997 at Canada. The specification of variety is summarized in Table 3.

Table 1: Climatic characteristics of Sarab desert in cropping season of 2012-2013 (Source: synoptic weather station of Sarab)

Month	total monthly rainfall (mm-m)	Number of rainy days	Relative humidity (%)			Temperature (Celsius)			Number of frost days
			Min	max	mean	Min	max	mean	
October	10.6	5	22	82	52	3.7	22.8	13.2	1
December	20.9	8	40	90	65	1.4	14.4	7.9	9
November	28.1	13	49	93	71	-3	6.9	1.9	21
January	6.8	2	41	89	65	-9.6	3.2	-3.2	27
February	21.5	7	17	100	69	-4.4	6.5	2.4	24
March	12.8	7	33	90	62	-2.8	9.7	3.5	22
April	27.2	8	24	81	52	0.5	16.2	8.4	13
May	46.7	12	9	100	60	4.7	14.5	10.3	3
June	15.7	7	22	83	52	8.3	24.6	16.4	0
July	6	2	27	80	54	27.9	10.2	19.1	0
August	5.1	2	31	82	57	11	27.4	19.2	0
September	1	1	18	75	46	8.5	28.3	18.4	0

Table 2: Physicochemical results of soil samples from experimental field

Clay %	Silt %	Sand %	Absorbable Potassium P.P.M	Absorbable Phosphorus P.P.M	Total nitrogen %T.N	organic carbon %T.N	Percentage of %T.N	Saturation Soil acidity pH	Electrical conductivity Ec*103	Depth
36	46	18	600	11.2	0.071	0.66	6.25	7.77	1.29	0-30

Table 3: Characteristics of studied cultivars (Untitled, 2013)

Dry matter	Consumption type	Plant height	Flower color	cortex color	flesh color	Maturity	cultivars
-	edible	Tall	yellow	Pale yellow	Dark yellow	Moderate-serotinous	Agria

The trial was conducted in form of split- split plot based on randomized complete block design with three replications. This experiment with 3 factors included: A: usage of urea chemical fertilizer as the main factor in 5 levels: (A_1: control: without using urea, A_2: 25%, A_3: 50%, A_4: 75% and A_5: 100% of recommended amount based on soil test), B: consumption of Nitroxin biological fertilizer as subordinate factor in 2 levels: B_1: rubbed tuber with 10 liters per hectare, B_2: rubbed tuber with 20 liters per hectare; C: consumption of avian enriched organic manure (Maghafer) as sub-subordinate factor in 2 levels: C_1: soil usage before planting at rates of 1500kg per hectare and C_2: soil usage before planting at rates of 1800kg per hectare. In this study length and width of each replication were 60 meters and 4 meters, respectively. Number of rows in each sub plot was 3 rows and 15 tubers were planted on each row. Rows spacing and plants spacing were 75 cm and 20 cm, respectively. Number of experimental plots in each replication was 20 and replications interval were 2 meters. On fall 2012, fall plowing was carried out with moldboard plow in form of two-time interaction perpendicular to crush and pulverize clods. Fertilizers of triple super phosphate and zinc sulphate were used uniformly on fall with rates of 50 kg per hectare, after tillage based on soil test results. On 18 and 19 May, the tubers of potato varieties were planted based on planting map. For treatments of rubbed tubers with Nitroxin (with concentration of 10 liters and 20 liters per hectare), in shade condition; tubers were imbrued with fertilizer and then were planted quickly. In spring before planting the tubers, Maghafer fertilizer in two levels (1500 kg/ha and 1800 kg/ha) was strewed bandy inside of runnel and mound and then was mixed with soil by Bill. Urea fertilizer was applied based on soil test with amount of 300 kg/ha in form of installment into 3 phases (first phase: after sowing, second phase: establishment, third stage: flowering). Based on experimental treatments, amounts of urea fertilizer were zero, 75, 150, 225 and 300 kg/ha. establishment for each plants was carried out at all plots in two stages; first in stage of before tubers creation in form of mechanization, then in form of handy at stage of initiation in tubers creation. Irrigation was carried out after emergence in accordance with local custom. Weeding was performed in two stages, first in form of mechanization and then handy. Harvesting was done on 29 September. In this study, tuber weight per plant, weight of tuber smaller than 35 mm, weight of tuber between 35- 55 mm, weight of tuber larger than 55 mm, yield of marketable tubers per area unit and tuber yield per area unit were evaluated. Before analysis of variance, assumptions of normality in deviations distribution and variances homogeneity were examined. Mean comparisons of traits were carried out using Duncan's multiple range tests at 5% probability level. For statistical calculations, draw figures and tables, computer software of MSTAT-C, SPSS-22, and Excel were used.

RESULTS AND DISCUSSION

Results of variance analysis for studied traits have been presented in Table 4. In this assessment, interactions of three factors were significant for all studied traits.

Table 4: Analysis of variance for on studied traits of Agria variety

S.O.V	df	Tuber weight per plant	Tuber weight smaller than 35 mm	Tuber weight between 35- 55 mm	Tuber weight larger than 55 mm	Marketable tuber yield	Total tuber yield
Replication	2	0.013	0.001	0.0005	20.63*	0.468	0.453
Urea fertilizer (A)	4	0.192**	0.225**	0.79**	33.739**	0.886**	5.746**
Error A	8	0.007	0.003	0.027	0.544	0.217	0.222
Notroxin (B)	1	0.005	0.014	0.639**	1.11	0.02	0.005
B×A	4	0.145**	0.143**	0.189**	11.55**	2.038**	1.923*
Error B	10	0.004	0.005	0.016	1.008	0.298	0.329
Maghafer fertilizer (C)	1	0.203**	0.007	0.115	17.067**	5.612**	5.406**
C×A	4	0.023*	0.032**	0.425**	1.581**	0.289*	0.232
C×B	1	0.045*	0.044**	1.207**	10.753**	1.329**	0.0091**
C×B ×A	4	0.049**	0.046**	0.689**	5.715**	1.523**	1.57**
Error	20	0.007	0.004	0.04	0.297	0.127	0.132
CV (%)		4.81	15.46	6.94	3.93	4.01	4

**and **: represent significant difference at 5% and 1% probability levels, respectively.*

Tubers Weight per Plant

Number of tuber influence on yield through weight of tuber and this means that although number of tubers has great impact on yield, but this effect applied by weight. From the view point of 3-way interaction of urea fertilizer levels× Nitroxin fertilizer levels× levels of avian enriched organic manure (Table 4), $A_4B_1C_2$ compound with average of 2.06kg had the highest weight of tubers per plant and was sited in the superior statistical group together with compounds of $A_5B_1C_1$, $A_5B_2C_1$ and $A_1B_1C_1$. Combinations of $A_2B_2C_1$ (1.45 kg) and $A_5B_2C_2$ (1.43 kg) had the lowest weight of tubers per plant and were in class k. 1800kg consumption of Maghafer fertilizer lead to significant reduction (7.14%) in weight of tuber per plant in terms of control as compared with 1500kg consumption of Maghafer fertilizer. But 1800kg consumption of Maghafer fertilizer lead to significant increment (1.32% and 7.3%, respectively) in weight of tuber per plant in terms of 25% and 50% of recommended amount as compared with 1500kg consumption of Maghafer fertilizer. While, 1800kg consumption of Maghafer fertilizer caused to significant decrement in tuber weight (11.22% and 17.09%, respectively) in terms of 75% and 100% of recommended amount as compared with 1500kg consumption of Maghafer fertilizer. Treatment of rubbed tuber with 10 liters/ha of Nitroxin fertilizer, leads to significant reduction (1.36%, 5.16%, 4.54% and 9.19%, respectively) in tuber weight in terms of no consumption of urea and consumption of 25%, 50% and 100% of recommended amount as compared with rubbed tuber with 20 liters/ha of Nitroxin fertilizer. While rubbed tuber with 10 liters/ha of Nitroxin fertilizer caused to significant augmentation (11.22%) in tuber weight per plant in terms of 75% of recommended amount in comparison with rubbed tuber with 20 liters/ha of Nitroxin fertilizer.

Weight of Tubers Smaller than 35mm

From the view point of 3-way interaction of urea fertilizer levels× Nitroxin fertilizer levels× levels of avian enriched organic manure (Table 4), combinations of $A_2B_1C_2$ and $A_2B_2C_2$ with averages of 0.85kg and 0.77kg, respectively; had the highest weight of tubers which were smaller than 35mm and were sited in the superior statistical group. $A_3B_2C_2$ compound with average of 0.17 kg had the lowest weight of tubers which were smaller than 35mm and was allocated to class j. Having tiny tubers will be cause to less production of marketable tubers with high yield. Dadashzadeh (2012) reported, combination of (Agria × control × control) with average of 1.167gr had the highest weight of tubers which were smaller than 35mm and compound of (savalan× equivalent of recommended amount based on soil test × control) with average of 0.2333g had the lowest weight of tubers which were less than 35mm. 1800kg consumption of Maghafer fertilizer lead to significant reduction in weight of tubers smaller than 35mm in terms of no consumption of urea fertilizer, consumption of 25%, 50%, 75% and 100% of recommended amount with rates of 33.33, 49.97, 46.80, 11.22 and 9.67%, respectively as compared with 1500kg consumption of Maghafer fertilizer; so 50% usage of nitrogenous fertilizer together with 1800kg of Maghafer fertilizer prevented from production of tiny tubers until 50%. Overuse of urea fertilizer caused to production of smaller tubers due to stimulation in production of new stolon. Treatment of rubbed tuber with 10 liters/ha of Nitroxin fertilizer, leads to significant reduction in weight of tubers smaller than 35mm in terms of no consumption of urea and consumption of 25% and 100% of recommended amount (4.65%, 8.95% and 18.18%, respectively) as compared with rubbed tuber with 20 liters/ha of Nitroxin fertilizer. While, rubbed tuber with 10 liters/ha of Nitroxin fertilizer; caused to significant increase in weight of tubers smaller than 35mm in terms of 50% and 75% of recommended amount (42.85% and 18.18%, respectively) in comparison with rubbed tuber with 20 liters/ha of Nitroxin fertilizer.

Weight of Tubers between 35- 55mm

$A_3B_2C_2$ compound with average of 4.08kg had maximum weight of tubers between 35-55mm and was sited in the superior statistical group together with $A_2B_1C_2$ compound. Combination of $A_3B_2C_2$ with average of 1.85kg had minimum weight of tubers between 35-55mm and was in class i. 1800kg consumption of Maghafer fertilizer lead to significant augmentation in weight of tubers between 35-55mm in terms of no consumption of urea fertilizer and 25% of recommended amount (6.08% and 6.7%, respectively) as compared with 1500kg consumption of Maghafer fertilizer. While, 1800kg consumption of Maghafer fertilizer caused to significant decrement in weight of tubers between 35- 55mm in terms of 50% and 75% of recommended amount (34.46%, 6.54%, respectively) as compared with 1500kg consumption of Maghafer fertilizer. Treatment of rubbed tuber with 10 liters/ha of Nitroxin fertilizer, leads to significant reduction in weight of tubers between 35-55 mm in terms of 25% and 75% of recommended amount (19.61% and 0.75%, respectively) as compared with rubbed tuber with 20 liters/ha of Nitroxin fertilizer. While, rubbed tuber with 10 liters/ha of Nitroxin fertilizer, caused to significant increase in weight of tubers between 35-55mm in terms of 50% recommended amount (9.46%) as compared with rubbed tuber with 20 liters/ha of Nitroxin fertilizer (Table 4).

Weight of Tubers Greater than 55mm

$A_4B_1C_2$ compound with average of 17.4 kg had the highest weight of tubers greater than 55mm and was in class a. Combinations of $A_3B_2C_1$ and $A_2B_1C_2$ with averages of 10.54kg and 10.62kg, respectively; had the lowest weight of tubers greater than 55mm and were in class j. 1800kg consumption of Maghafer lead to significant decrease in weight of tubers greater than 55mm in terms of no consumption of urea, 25% and 100% of recommended amount with rates of 2.02%, 3.87% and 14.41%, respectively; as compared with 1500kg consumption of Maghafer. While, 1800kg consumption of Maghafer caused to significant augmentation in weight of tubers greater than 55mm in terms of 50% and 75% of recommended amount with rates of 17.45% and 11.21% as compared with 1500kg consumption of Maghafer. Rubbed tubers with 10 liters/ha of Nitroxin fertilizer, lead to significant decrease in weight of tubers greater than 55mm in terms of no consumption of urea, consumption of 25%, 50%, 75% and 100% of recommended amount with rates of 7.26%, 0.62%, 6.22%, 12.58% and 8.12% as compared with rubbed tuber with 20 liters/ha of Nitroxin fertilizer (Table 4).

Marketable Tuber Yield

$A_4B_1C_2$ compound with average of 10.8kg per area unit showed the highest yield of marketable tuber and was in class a. Combination of $A_2B_2C_1$ with average of 7.3kg per area unit had the lowest yield of marketable tubers and was sited in class h. 1800kg consumption of Maghafer lead to significant increase in yield of marketable tuber in terms of 50% and 75% usage of recommended amount with rates of 7.73% and 8.95%, respectively; as compared with 1500kg consumption of Maghafer. But, 1800kg consumption of Maghafer caused to significant reduction in yield of marketable tuber in terms of 100% usage of recommended amount with rate of 11.55% as compared with 1500kg consumption of Maghafer. Rubbed tubers with 10 liters/ha of Nitroxin fertilizer, lead to significant decrease in yield of marketable tuber in terms of no consumption of urea, consumption of 50%, 75% and 100% of recommended amount with rates of 5.92%, 3.38%, 10.83% and 7.18% as compared with rubbed tubers with 20 liters/ha of Nitroxin fertilizer (Figure 1).

Tuber Yield

$A_4B_1C_2$ compound with average of 10.9kg per area unit, demonstrated the highest tuber yield and was sited in class a. Combination of $A_2B_2C_1$ with average of 7.6kg per area unit, had the lowest tuber yield and was allocated to class h. 1800kg consumption of Maghafer lead to significant reduction in tuber yield in terms of no consumption of urea and 100% usage of recommended amount with rates of 6% and 13.23%, respectively; as compared with 1500kg consumption of Maghafer.

But use of 50% and 75% of recommended amount together with 1800 kg consumption of Maghafer caused this trait were equal with 6 and 9.32, respectively; as compared with 1500kg of Maghafer.

Rubbed tubers with 10 liters/ha of Nitroxin fertilizer, lead to significant decrease in tuber yield in terms of no consumption of urea, consumption of 25%, 75% and 100% of recommended amount with rates of 5.76%, 5.45% 9.32% and 5.61% as compared with rubbed tuber with 20 liters/ha of Nitroxin fertilizer and only rubbed tubers with 10liters/ha of Nitroxin fertilizer together with 50% of recommended amount caused to significant augmentation in tuber yield with rate of 1.72%, as compared with rubbed tuber with 20 liters/ha of Nitroxin fertilizer.

Combination use of biological, chemical and organic fertilizers as alternative for chemical fertilizers can increase tuber yield of potato with creating balance among soil elements and improve rhizosphere conditions such as decreasing in soil pH (Mohammadiarya *et al.,* 2010) and enhancement in absorbency of nutrient elements.

Dadashzadeh *et al.,* (2013) reported that control treatment with yield of 47.71 tons/hectare as compared with treatments of rubbed tubers with 10 liters/ha and 20 liters/ha, indicated yield augmentation with amounts of 14.06% and 1.35%, respectively.

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Table 5: Mean comparisons of studied traits in Agria variety

Urea× Nitroxin× Maghafer			**Tuber weight (kg/plant)**		**Tuber weight smaller than 35 mm (kg)**		**Tuber weight between 35- 55 mm (kg)**		**Tuber weight larger than 55 mm (kg)**	
Control	Maghafer 1500	rubbed tuber with 10 Lit/ha	1.93	abc	0.576	bc	2.92	cde	15.8	bcd
	Maghafer 1800	rubbed tuber with 20 Lit/ha	1.7	f-i	0.45	def	2.68	d-g	12.85	h
	Maghafer 1500	rubbed tuber with 10 Lit/ha	1.57	h-k	0.296	ghi	2.86	c-f	13.63	gh
	Maghafer 1800	rubbed tuber with 20 Lit/ha	1.79	c-f	0.38	efg	3.08	c	14.45	efg
25% of recommended amount based on soil test	Maghafer 1500	rubbed tuber with 10 Lit/ha	1.58	h-k	0.5	cd	3.55	b	11.75	i
	Maghafer 1800	rubbed tuber with 20 Lit/ha	1.43	k	0.45	def	2.85	c-f	11	ij
	Maghafer 1500	rubbed tuber with 10 Lit/ha	1.53	jk	0.85	a	3.78	ab	10.61	j
	Maghafer 1800	rubbed tuber with 20 Lit/ha	1.51	jk	0.767	a	3.05	cd	11.25	ij
50% of recommended amount based on soil test	Maghafer 1500	rubbed tuber with 10 Lit/ha	1.73	e-h	0.32	ghi	2.87	c-f	13.96	fg
	Maghafer 1800	rubbed tuber with 20 Lit/ha	1.56	ijk	0.626	b	4.08	a	10.54	j
	Maghafer 1500	rubbed tuber with 10 Lit/ha	1.78	c-f	0.336	f-i	2.5	fgh	14	fg
	Maghafer 1800	rubbed tuber with 20 Lit/ha	1.79	c-f	0.167	j	1.85	i	15.68	bcd

75% of recommended amount based on soil test	Maghafer 1500	rubbed tuber with 10 Lit/ha	1.87	b-e	0.24	hij	2.45	gh	15.5	bcd
	Maghafer 1800	rubbed tuber with 20 Lit/ha	1.61	g-j	0.487	cde	3.05	cd	13.5	gh
	Maghafer 1500	rubbed tuber with 10 Lit/ha	2.06	a	0.247	hij	2.9	cde	17.4	a
	Maghafer 1800	rubbed tuber with 20 Lit/ha	1.86	b-f	0.357	fgh	2.25	h	15.25	cde
100% of recommended amount based on soil test	Maghafer 1500	rubbed tuber with 10 Lit/ha	1.95	ab	0.31	ghi	2.64	efg	16.4	b
	Maghafer 1800	rubbed tuber with 20 Lit/ha	1.91	a-d	0.31	ghi	2.75	c-g	15.95	bc
	Maghafer 1500	rubbed tuber with 10 Lit/ha	1.75	d-g	0.337	f-i	2.76	c-g	14.88	def
	Maghafer 1800	rubbed tuber with 20 Lit/ha	1.45	k	0.23	ij	2.72	c-g	12.8	h

Means in each column with the same letter have not significant different at 5% probability level.

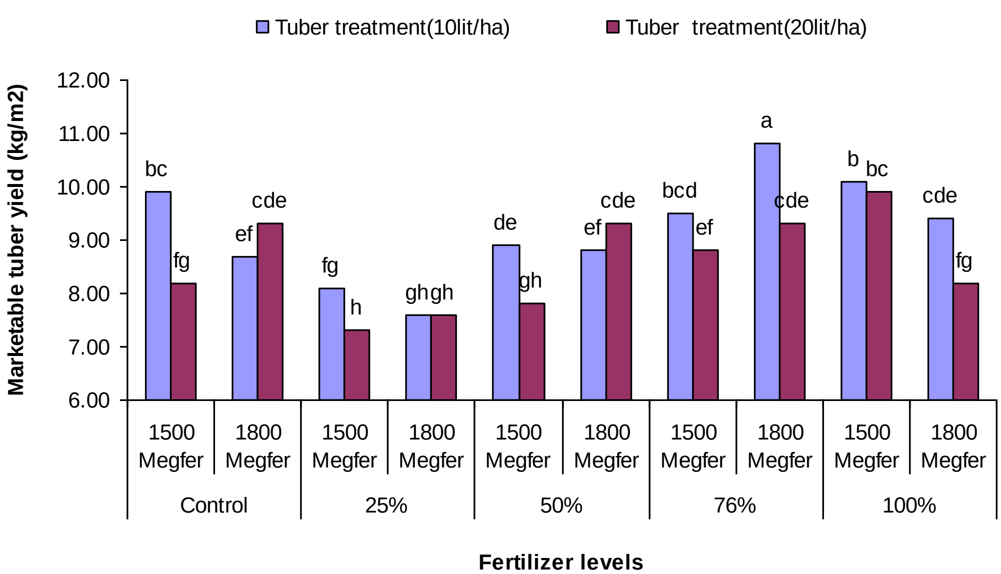

Figure 1: Effect of Nitrogen levels, Nitroxin and Maghafer on Agria marketable tuber yield

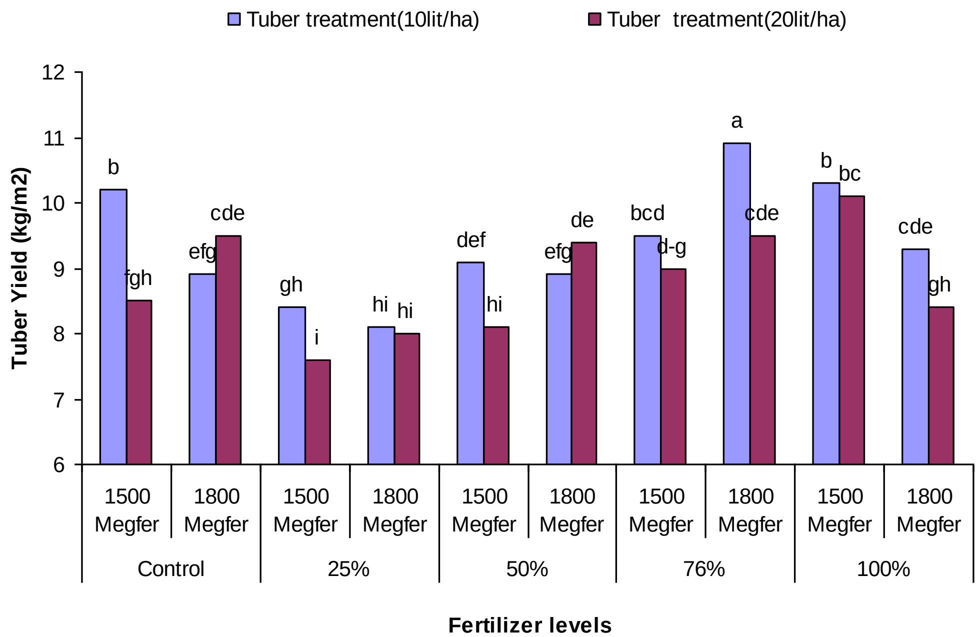

Figure 2: Effect of Nitrogen levels, Nitroxin and Maghafer on Agria tuber yield

Also, from the view point of marketable tuber yield, control treatment with yield of 46.92 tons/hectare as compared with treatments of rubbed tubers with 10 liters/ha and 20 liters/ha represented yield increment with rates of 15.70% and 5.52%, respectively. Among all the studied varieties, Agria was superior from the view point of all measured traits (except, number of main stem per plant, tuber yield and marketable tuber yield) (Figure 2).

Conclusion

Marketable tuber yield and tuber yield increase in terms of 10 liters usage of Nitroxin as compared with 20 liters with amounts of 0.45% and 0.22%, respectively. Marketable tuber yield and tuber yield in 75% of recommended amount of urea fertilizer based on soil test demonstrated augmentation as compared with control treatment (zero concentration of urea fertilizer) with rates of 5.58% and 4.92%. Marketable tuber yield and tuber yield represented increment in combination of (100% of recommended amount× 1800 kg/ha usage of Maghafer× 10 liters usage of Nitroxin manure) as compared with combination of (control× 1500 kg/ha consumption of Maghafer× 10 liters consumption of Nitroxin manure) with amounts of 4.61% and 3.06%.

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