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Effect of Manure Application on Reduced Nitrogen Fertilizer Consumption in Potato Cv. Agria

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ABSTRACT

Objective: An experiment was performed in Ardabil (2012) to investigate the effects of manure consumption in different amounts on reducing nitrogen fertilizer consumption in potato cv. Agria. **Methods:** This research was conducted in factorial design based on randomized completely blocks design in three replication in which two manure factors in three levels (control, 30 and 60 tons/h) and nitrogen fertilizer in 4 levels (25%, 50%, 75% and 100% recommended) were investigated. **Results:** Results showed that increased manure usage led to increased tuber yield, and the most yields were obtained from 60 tons/h manure usage. Manure causes increased tuber's average weight per plant, number of tubers per plant, tubers average weight, plant's wet and dry weight, plant height and tuber's nitrate. Also, nitrogen fertilizer caused increased potato tuber yield in which the most yields were obtained from nitrogen fertilizer up to 100% recommended, and it also caused other properties increase. Significantly, increased nitrogen usage increased tubers nitrate and tubers nitrate obtained from nitrogen fertilizer up to 100% recommended. Results from variance analysis showed that manure-nitrogen fertilizer interaction in growth properties was not significant but, in 1% probability level it was statistically significant in tuber and nitrate yield components properties. Increased manure usage from recommended 30 to 60 tons/h and nitrogen from 50 to 75 percent have had better effects on total properties, especially in terms of nitrate accumulation. So, the highest yields were obtained from manure usage up to 60 tons/h.

1. INTRODUCTION

Potato (*Solanum tuberosum*) is one of the strategic products which play an important role in human nutrition and also it serves as a main food in most countries. Potatoes Nutrition importance is for its high energy and moreover, various kinds of vitamins, especially C, in combination of other minerals and necessary proteins has made it a valuable food full of carbohydrates all over the world. (Rezaei and Soltani, 1996). In sustainable agriculture, soil and its optimal use is so important. Hence, soil protection and proper nutrition is effective in increasing yield. Manure is added approximately 20-50 tons/h in soil for valuable plants culture such as vegetables, potatoes, corns, cotton and

beets. But in recent years they have been reconsidered for efficacy of organic materials on agricultural productivity. Nitrogen is one of necessary elements for plants growth, and mostly it is introduced in nitrogen containing fertilizers. (Kashi and Hassan Dokht 1999). The main part of required nitrogen for plant is absorbed in nitrate form (NO_3) and excessive accumulation of nitrogen in products such as potatoes can risk consumer's health. Also, excessive use of nitrogen containing fertilizers leads to groundwater resources pollution. Some amount might be accumulated in tubers as a result of excessive use of nitrogen fertilizers and it will be a threat to human health in long time if this amount exceeds the permissive limit. The critical nitrate

toxicity in potato is 250 mg/kg (Malakouti, 1995 and Malakouti and Tabatabaei, 1998).

This study aimed the following purposes:

- 1- Determining degree of manure consumption in potato
- 2- Reduction of nitrate in tubers
- 3- Replacing chemical fertilizers by manure
- 4- Study of the methods of increasing production yield and healthy

2. MATERIALS AND METHODS

An experiment was performed in Ardabil (2012) to investigate effects of manure consumption in different amounts on reducing nitrogen fertilizer usage in potatoes cv. Agria. This research was conducted in factorial design based on randomized completely blocks design in three replications. Treatments included composted manure in control, 30 and 60 tons/h amounts and nitrogen fertilizer in 25, 50, 75 and 100 percent as recommended. This experiment measured properties such as plant height, plant's fresh weight, plant's dry weight, number of tubers per plant, average weight of tubers per plant, tubers yield per unit and nitrate content of tubers. After collection of data related to measured properties, variance analysis was done by M-State-C statistical software. We used Duncan's Multiple Range Test with 5% probability for Comparisons of average values.

3. RESULTS AND DISCUSSION

Variance analysis results showed that different amounts of manure usage has meaningful significant effects on plant height, fresh and dry weight in 1% probability level. (Table1) manure usage in most of researches has led to increased plant height, wet and dry weight for potatoes and other plants including following cases. It is reported that plant height increases as a result of increased manure usage from 0 to 20 and 30 tons/h. (Hassan Dokht et al, 1998). Variance analysis results showed that different amounts of nitrogen usage has, statistically, significant differences on plant height, wet and dry weight in 1% probability level. (Table1).

Zare Feizabadi et al (2004) reported that plant's fresh weight increased as a result of increasing nitrogen fertilizer usage. Also, nitrogen amounts have significant differences on fresh and dry weight of potato shoots which corresponds to our results. Variance analysis results showed that different amounts of manure usage has meaningful significant differences on number of tubers per plant, tubers weight per plant, average weight and yield of tuber, and nitrate content of tubers in 1% probability level. (Table 1). Generally, manure consumption up to 60 tons/h had the most yield components of tuber and nitrate content, and no manure usage had the least yield components. Increased manure usage had no significant effect on increasing nitrate

content of tubers and, in general despite its properties, manure doesn't cause nitrate accumulation in tubers. Potato shows well response to manure and, not only its consumption leads to supplied nitrogen, phosphorus and potassium, but also improvement of seedbed and maintenance of soil moisture (Rezaei and Soltani, 1996). Despite significance of manure-nitrogen usage interaction in yield and yield component of potato, it can be concluded that more than 30 tons of manure consumption can reduce 25%, and in some cases, 50% nitrogen usage without imposing any serious damage to yield. Manure consumption is considered to affect physical, chemical and biological properties of soil as well as the most important nutrition resource of it, and the resultant of manure effects on soil properties has caused the increased number of tubers per plant and its yield. Kouchaki et al. (2004) reported that manure consumption rise from 0 to 60 tons/h increased the number of potato tubers which corresponds to our results. Variance analysis results showed that various amounts of nitrogen fertilizer had, statistically, significant difference on the number of tubers per plant, tubers weight per plant, average weight, yield and nitrate content of tuber in potato in 1% probability level. (Table 1) generally, nitrogen fertilizer consumption recommended up to 100% had the least yield component with the most yield component of recommended 25% nitrogen consumption. However, increased weight per plant and average weight of tubers in recommended 75% nitrogen consumption and higher had no significant difference. Growth increased with nitrogen fertilizer consumption so it causes increased photosynthesis and, consequently, increased yield. Raeisi and Khaje Pour (1992) reported a significant effect of nitrogen on tuber yield. Moreover, nitrogen effect on 1% level was significant on increased potato production. Despite the fact that critical nitrate toxicity for potato is 250 mg/kg and significant part of produced potato is used in food industries, so considering potato's quality from industrial consumption point of view is increasing and production of high quality potatoes have special importance. Hence, nitrogen management in potato culture is so important for determining the amount and appropriate time of nitrogen fertilizer consumption to access high quality tubers. It is shown that we can produce low nitrate content product by coordinating plant's required time and nitrogen fertilizer consumption while maintaining the highest yield. (Abbasi, 2000). Also Yazdan Doust Hamedani (2003) reported that increased nitrogen fertilizer led to increased nitrogen concentration in tuber which corresponds to our results. Variance analysis results showed that interaction between different amounts of manure consumption was, statistically, significant on number, yield and nitrate content of tubers in 1% probability level (Table1).

Table 1:

mean squares and variance analysis results of studied properties in potato

S.O.V	df	Mean of Square			
		Tuber yield	Plant's fresh weight	Plant's dry weight	Plant height
Repetition	2	0.194 ^{ns}	1.932 ^{ns}	0.074 ^{ns}	1.422 ^{ns}
Manure (A)	2	1424.528 ^{**}	157.372 ^{**}	8.206 ^{**}	1459.19 ^{**}
Nitrogen fertilizer (B)	3	135.657 ^{**}	27.547 ^{**}	1.433 ^{**}	42.673 ^{**}
A × B	6	2.157 ^{**}	0.835 ^{ns}	0.067 ^{ns}	2.164 ^{ns}
Error	22	0.528	0.589	0.039	1.015
C.V%		1.86	5.75	6.39	1.63

Continued Table 1:

mean squares and variance analysis results of studied properties in potato

S.O.V	df	Mean of Square			
		Average weight of tuber	Number of tubers per plant	Tuber weight per plant	Nitrate content
Repetition	2	4.083 ^{ns}	0.049 ^{ns}	0.000 ^{ns}	2.194 ^{ns}
Manure (A)	2	2118.083 ^{**}	28.791 ^{**}	0.887 ^{**}	28.861 ^{**}
Nitrogen fertilizer (B)	3	308.102 ^{**}	1.459 ^{**}	0.085 ^{**}	18217.963 ^{**}
A × B	6	9.713 ^{ns}	0.098 [*]	0.001 ^{**}	10.935 ^{**}
Error	22	3.902	0.034	0.000	1.77
C.V%		1.91	1.98	1.67	1.68

CONCLUSION

In many of treatments, increased nitrogen consumption had no significant effect on increased yield components, but it had a significant effect on nitrate accumulation in tuber which should be paid more attention. And we should reduce nitrogen consumption in order to control tuber's nitrate content and instead, increase organic fertilizers use. 30 tons/h composted manure consumption has been completely effective in potato's quantitative and qualitative improvement so that only 60 tons/h composted manure consumption can be recommended, although 30-60 tons/h consumption has positive effects along nitrogen use. While nitrogen without recommended 100% manure must be applied for principles of good practice, but despite the interaction significance of these two factors for some of the properties, in case of manure consumption there is no need for recommended 100% nitrogen consumption and it can be reduced to less than recommended 75%. In general, it can be concluded that in these ambient conditions, we can produce healthy potato products with low nitrate content tuber and maximal yield by 60 tons/h manure usage. And nitrogen consumption can be reduced by 25% and nitrate accumulation in tubers and groundwater and soils is prevented.

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