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ARTICLE

EFFECTS OF DIFFERENT NITROGEN AND SOLUPOTASSE FERTILIZER RATE ON YIELD AND YIELD COMPONENTS OF POTATO

Aazadeh Hosseini[1], Seyed Hossein Nemati[2], Mohamad Khajehosseini[3*] and Hossein Aroiee[4]

[1,2,4] *Dept of Horticulture, Ferdowsi University of Mashhad International Campus, Mashhad, IRAN*

[3]*Dept of Agriculture, Ferdowsi University of Mashhad, Mashhad, IRAN*

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ABSTRACT

The effect of different nitrogen and Solupotasse fertilizer levels on yield and tubers quality, germination percentage and rate after storage was investigated in a split plot experiment based on a RCBD with three replications, in 2014. The main plot and subplot were four N fertilizer levels (0, 125,250 and 375 kg N/ha) and four K fertilizer levels (0, 2,4 and 6 kg K/ha) respectively. The results showed that the main effect of N and K fertilizer were significant on mean tuber number and fresh tuber yield at P>1% and germination percentage at 5% probability level. The interaction effect was significant on mean tuber number, and fresh tuber yield at P>1% and starch percentage at P>5%. It showed that the application of 375 kg N/ha had a significant effect on measured traits and ranked in the superior group. Also application of 0 kg/ha solupotasse was ranked in the superior group. For tuber number per plant, application of N fertilizer 375 kg/ha and K fertilizer 4 kg/ha, in terms of fresh tuber yield, application of N fertilizer 375 kg/ha and K fertilizer 0 kg/ha and for starch percentage, application of N fertilizer 0 kg/ha and K fertilizer 4 kg/ha ranked in the superior group.

KEY WORDS
Germination, Storage, Starch, Tuber number.

INTRODUCTION

Potato is one of the main tubers and nutritious crops, which also is very important due to nutritive value and economical. This crop with high performance in unit level is containing abundant carbohydrate and also biological value of protein is high [Mohammadi, 2000].

Studies have shown that utilization of microelements cause development of performance and quality of crops . Enrichment of agriculture crops for increasing of healthy level of society production of seeds with high growth rate and sprout rate is very beneficial [Mohammadi, 2000]. Potassium acts as an osmoticum in plants and is important for the translocation of sugars and synthesis of starches in potatoes [Harris, 1978, Kunkel and Thornton, 1971]. Fertilizer K applications are often required for optimum potato yields because of a relatively high K requirement compared with other irrigated crops. Fertilizer K-source is known to affect tuber specific gravity (SG). [Dubetz and Bole 1975] observed no K effect on yield, number of tubers, or weight of tubers at various N rates, but K decreased SG.

Fertilizer N applications are generally needed since the mineralization of soil organic N does not satisfy the N requirements of the potato plant [Mcdole et al, 1991]. Belanger et al.[2000] found that application of appropriate amounts of nitrogen [80 kg/ha] resulted in more favorable effects than higher rates. Waddell et al. [1999] and Saeidi et al. [2009a , 2009b] reported that application of nitrogen, led to increase in tuber yield than control. This rate has been obtained 34.3% by Marguerite et al. [2006].

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Nutrient management is a controllable input that potato growers utilize to ensure high tuber yields and quality. Both N and K fertilization are often required for maximum production. Optimum recommendations can only be made if the specific effects of K-sources and their interaction with N rates are known. So the objective of nutritional quality and yield of potato tuber cultivar Agria, by applying nitrogen and solupotasse fertilizer levels and determine the best fertilizer rates to get the highest yield and quality of potato tuber along with the lowest environmental accumulation.

MATERIALS AND METHODS

The study area is located Jolge Rokh, Khorasan Razavi , Iran with longitude of 30°17' and latitude of 56°57' in 2013 – 2014. Annual average temperature in research area was 15.6° C and average rainfall was 260 mm and also it was 985 m higher than sea level.

A split-plot field design with four replication in a randomised block design was employed. Main plot provided four levels of nitrogen fertilization [0, 125, 250, 375 kg per ha] . Each Main plot was subdivided into two levels of solupotasse fertilization [0, 2, 4, 6 kg per ha] . Solupotasse solution was sprayed in three stages. Phosphate application remained constant for each level of solupotasse.

Whole amount of phosphate and third of the urea at the time of preparing seed bed was used. Seed cultivation with density 12.5 plants per m2 at May, was done, plants distance on rows were 20 cm. Rows were spaced 40 cm and plots contained 5 rows each 3 meters. Control of weed was done through mechanical and in two times manually. Three plants selected randomly, then plants were transferred to the laboratory. This experiment measured properties such as number of leafs, number of branch, plant height, number and weight of tubers per plant, average weight of tubers per plant, tubers yield per unit,

***Corresponding Author**
Email:
hhosseini58@yahoo.com

starch percentage and leaf chlorophyll content . In order to calculate starch percent of tuber, Mccriddy et al. [1950] method was used. Leaf chlorophyll content measured using chlorophyll meter device [model: SPAD-502] were calculated.

After harvesting five tubers from each plot randomly selected and stored in refrigerator at 7 °C for 90 days. Following the expiration of 90 days, samples were taken for experimental analysis. After reconditioning, for 10 days germination percentage and germination rate measured.

Results were analyzed by SAS software, mean comparisons were done via Duncan's multiple range test and graphs were drawn by Excel software.

Table 1 : Soil characteristics examined at the depth of 0 – 30 cm

Texture	pH	Ec ds/m	TNV %	O.C %	Sand %	Silt %	Clay %	P (mg/kg)	K (mg/kg)
Sandy Silt	7.9	1.78	17.6	0.56	41	35	24	12.0	213

RESULTS AND DISCUSSION

Mean leaf number/plant

Analysis of variance [Table 2] showed that the main effect of N fertilizer was significant on mean leaf number at 1% probability level. The main effect of K fertilizer and N fertilizer × k fertilizer on leaf number was not significant. Also, means comparison table [Table 3] showed that all four K fertilize levels had no significant differences in their leaf number and were ranked in same group. Among N fertilizer levels, application of 375 kg N/ha gave rise to the greatest leaf number. The results were not in agreement with Vos [1995] who reported that the effect of different N fertilizer level was significant on Branch number and declined with increase in nitrogen supply.

Table 2: Analysis of variance of effect of N and K fertilizer levels on different traits of potato

Source of variance	df	Mean leaf number	Mean branch number	Mean plant height	Mean tuber number	Mean tuber weight	Fresh tuber yield	Dry matter percentage	Starch percentage	Leaf chlorophyll content	Germination percentage	Germination rate
Replication	2	1.31	2.27	3.06	0.89	2515525	13.77*	0.49	3.55	26.02	681.58**	1.08
N Fertilizer	3	48.55	16.74*	449.38**	295.8**	3415563.30	2305.38**	2.47*	1.64	189.16	217.52	34.05*
R*N	6	0.78	3.24	1.36	14.72	6180258.80	2.15	0.34	1.97	135.23	54.08	3.80
K Fertilizer	3	1.05	068	0.16	5.55*	10837.13	29.55**	0.36	0.30	63.01	146.90*	47.77
N*K	9	0.53	1.66	1.37	7.16**	92456.10	13.64**	0.39	0.99*	79.09	46.65	38.87
R*N*K	24	0.5	2.77	0.81	1.65	68759.11	0.56	0.27	0.33	34.67	37.48	27.68

* and ** show significance at 5% and 1% probability level.

Table 3: Means comparison of effect of different N and K fertilizer levels on different traits of potato

Source of variations	Men leaf number / plant	Mean branch number / plant	Mean plant height (cm)	Mean tuber number / plant	Mean tuber weight / plant	Fresh tuber yield (t/ha)	Dry matter percentage (%)	Starch percentage (%)	Leaf chlorophyll content	Germination percentage	Germination rate
N Fertilizer levels											
0 kg/ha	11 b	5.75 a	50.75 d	17.08 b	2827.91 a	19.91 d	22.69 a	18.83 a	40.83 a	41.25 a	24.41 a
125 kg/ha	10.83 b	5.91 a	53.66 c	17.25 ab	2928.25 a	26 c	22.65 ab	18.04 a	45.35 a	37.16 a	28 a
250 kg/ha	12 b	7.91 a	60.5 b	24 a	2897.08 a	41.83 b	22.45 ab	18.19 a	45.15 a	42.5 a	26.33 a
375 kg/ha	15.16 a	7.8 a	64.08 a	27 a	3211.25 a	49.91 a	21.71 b	18.07 a	49.93 a	47.5 a	27.91 a
K fertilizer level											
0 kg/ha	11.91 a	6.83 a	57.16 a	20.83 a	2943.5 a	36.41 a	22.64 a	18.09 a	46.87 a	43.08 a	29.33 a

2 kg/ha	12.5 a	6.83 a	57.41 a	21.83 a	2980.91 a	34.41 b	22.27 a	18.09 a	43.46 a	45.41 a	27 a
4 kg/ha	12.08 a	7.16 a	57.25 a	22 a	2938.83 a	32.58 c	22.29 a	18.09 a	44.53 a	42.75 a	25.5 a
6 kg/ha	12.5 a	6.58 a	57.16 a	20.66 a	3001.25 a	34.25 b	22.32 a	18.09 a	46.39 a	37.16 a	24.83333 a

Mean branch number/plant

Analysis of variance [Table 2] showed that the main effect of N fertilizer was significant on mean branch number at 5% probability level. The main effect of K fertilizer and N fertilizer × k fertilizer on branch number was not significant. Also, means comparison table [Table 3] showed that all four K fertilize levels had no significant differences in their branch number and were ranked in same group. Among N fertilizer levels , application of 375 kg N/ha gave rise to the greatest leaf number. The results were in agreement with taghdiri and sepehri [2010] who reported that the effect of different N fertilizer level was significant on leaf number.

Mean plant height

Analysis of variance [Table 2] showed that the main effect of N fertilizer was significant on mean plant height at 1% probability level. The main effect of K fertilizer and N fertilizer × k fertilizer on mean plant height was not significant. Also, means comparison table [Table 3] showed that all four K fertilize levels had no significant differences in their mean plant height and were ranked in same group. Among N fertilizer levels, application of 375 kg N/ha gave rise to the greatest mean plant height. The results were in agreement with Jafari and Heidari [2014] who reported that the effect of different N fertilizer level was significant on plant height.

Mean tuber number/plant

The main effect of N fertilizer levels on mean tuber number/plant was significant at 1% probability level [Table 2]. The main effect of K fertilizer was significant at 5% probability level [Table 1]. Also N fertilizer × K fertilizer interaction was significant at 1% probability level [Table 1]. Also, means comparison table [Table 3] showed that among different N fertilizer levels, application of 125 kg N/ha was lower than the other three levels and other levels was ranked in the superior group. But all four K levels had no significant differences in their mean tuber number/plant and were ranked in same group. In N fertilizer ×K fertilizer interactions, application of 375 kg N/ha was better than the other levels at K level of 4 kg/ha and were ranked in superior group a. This is in agreement with foregoing researches [Aghighi et al, 2011;Saeedi, 2007; Koochaki, 2006, Bansal,2011].

Mean tuber weight/plant

Analysis of variance [Table 2] showed that the main effect of N fertilizer, K fertilizer and N fertilizer × K fertilizer on mean tuber weight per plant was not significant. Also, means comparison table [Table 3] showed that all fertilizer levels had no significant differences in their mean tuber number/plant and were ranked in same group. The results were not in agreement with Jafari and Heidari [2014], Zelalem[2009] who reported that the effect of different N fertilizer level was significant on tuber weight.

Fresh tuber yield

Analysis of variance [Table 2] showed that the main effect of N fertilizer , K fertilizer and N fertilizer × K fertilizer interaction was significant on fresh tuber yield at 1% probability level. Among N fertilizer levels, the fertilizer level of 375 kg had the strongest effect on fresh tuber yield and produced the highest yield. Also among K fertilizer levels, the fertilizer level of 0 kg had the strongest effect on fresh tuber yield and produced the highest yield. Among the interactions too, N fertilizer level of 375 kg/ha at K fertilizer level of 100 kg /ha ranked in the superior group and no-fertilizer level ranked in the inferior group. The increase in the application of N fertilizer up to a certain level increases the potato yield, but since then, it has no effect on the increase in yield [Westerman et al., 1985]. Jindong et al. [2006] stated that if the amount of applied fertilizer is greater than field capacity, the excessive fertilizer leaches to underground waters, which is harmful to ecosystems. Therefore, the recommendation regarding fertilizer type and level for a crop and field must be based upon genuine and delicate experiments. But This research was in agreement with Lie et al. [2003] who reported that high levels of fertilizer maximizes the net efficiency by neutralizing the adverse effects of soil quality on yield.

Dry matter percentage

Analysis of variance [Table 2] showed that the main effect of N fertilizer was significant on dry matter percentage at 5% probability level. The main effect of K fertilizer and N fertilizer × k fertilizer on dry matter percentage was not significant. Among N fertilizer levels, 0 kg/ha had the greatest effects on dry matter content and ranked in the superior group. The results were not in agreement with Moosavi et al. [2001] who reported that the effect of different N fertilizer level was insignificant on dry matter content. Krijthe [1982] reported that the excessive level of available N fertilizer stimulates reformation of tubers and may

Lead to the lengthening of tuber formation period and the difference in tubers maturity which in turn, leads to the difference in tubers dry matter content.

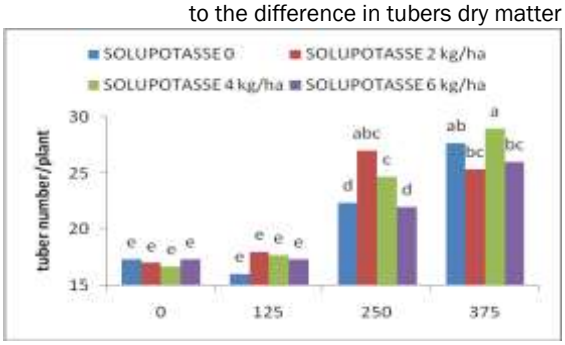

Fig. 1: Interaction between different N fertilizer levels and different K fertilizer on tuber number/plant.

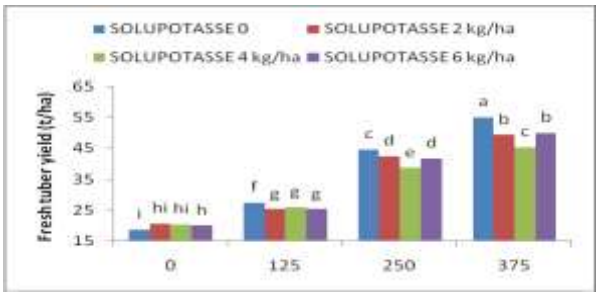

Fig. 2: Interaction between different N fertilizer levels and different K fertilizer on fresh tuber yield.

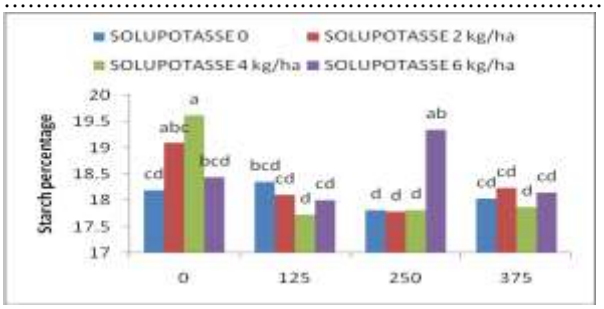

Fig. 3: Interaction between different N fertilizer levels and different K fertilizer on starch percentage.

Starch percentage

The main effect of N fertilizer and K fertilizer on starch percentage was not significant , But the interaction between them was significant on starch percentage at 5% probability level. According to means comparison table N fertilizer level of 0 kg/ha at K fertilizer level 6 kg/ha had the strongest effect on starch content and ranked in the superior group. Since starch forms 60-80% of dry matter, there was a special correlation between starch content and tuber dry matter. Starch is the main compound of potato tuber, making 3/4 of dry matter and depends mostly on cultivar. It plays an important role in the quality of products and is an important factor affecting potato cooking quality [Jafarian, 2000].

Leaf chlorophyll content

Analysis of variance [Table 2] showed that the main effect of N fertilizer, K fertilizer and N fertilizer × K fertilizer on leaf chlorophyll content was not significant. Also, means comparison table [Table 3] showed that all fertilizer levels had no significant differences in their mean leaf chlorophyll content and were ranked in same group. The results were not in agreement with Arshadi et al. [2012] who reported that the effect of different N fertilizer level was significant on leaf chlorophyll content

Germination percentage

Analysis of variance [Table 2] showed that the main effects of K fertilizer was significant on germination percentage at 5% probability level. The main effect of N fertilizer and N fertilizer × k fertilizer on germination percentage was not significant. Among K fertilizer levels, 0 kg/ha had the greatest effects on germination percentage.

Germination rate

Analysis of variance [Table 2] showed that the main effects of N fertilizer was significant on germination rate at 5% probability level. The main effect of K fertilizer and N fertilizer × k fertilizer on germination rate was not significant. Among N fertilizer levels, 125 kg/ha had the greatest effects on germination rate.

CONFLICT OF INTEREST

The authors report no conflicts of interest.

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FINANCIAL DISCLOSURE

None

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