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Effect of the Use of Macroelements on the Capability of Production of Two Variety of Flue-Cured Tobacco

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Abstract: In order to investigate the effect of macroelements on the capability of production of flue-cured tobacco, a factorial field experiment was conducted during 2008-2009 in tobacco research institute with tree replications and eight treatments. The used nitrogen fertilizer levels were 35-45-55-65 Kg N/ha as urea and the used potassium fertilizer levels were 150-200 Kg K_2O/ha as potassium sulphat. The used cultivars in this experiment were Coker 347 and K 326. According to the results, the effect of nitrogen on Coker347 cultivar yield in first and second years was significantly at the%1 level ($p<0.01$). Also the effect of nitrogen on K326 cultivar yield in both of years was significantly at the%5 level ($p<0.05$). The effect of potassium on Coker347 cultivar yield in first and second years was significantly at the%1 level ($p<0.01$). Also the interaction between nitrogen and potassium on Coker 347 cultivar yield was significant at the 1% level ($p<0.01$) in first year and 5% level ($p<0.05$) in second year.

Key words: Macroelements · Capability · Production · Flue-cured tobacco · Yield · Fertilizers

INTRODUCTION

Different varieties of tobacco like other agricultural plants during lifetime and different processes of growth need an exact extent of different substances so that the resulted leaves would have a good quality in scent, taste and being briquette and also have appropriate weight and leaf size. It must be mentioned that chemical fertilizer consumption in tobacco is a very sensitive issue; therefore, consumption of it should be together with enough science, information and experience. On the one hand, nutritious needs of tobacco is variable depending on variety, weather conditions, soil and so on and to determine appropriate amount of chemical fertilizer of tobacco it is necessary that investigation and research on variety or varieties would be done in cultivation place or at least those studies that have been done in similar conditions on the considered variety in other regions would be used as the source and resource [1]. Among food elements, nitrogen and potassium are usually the most important elements for using most of plants like tobacco. Among features of nitrogen fertilizer we can point out instability and wastage of major part of it after consumption in soil, so that efficiency of nitrogen fertilizers consumption in Iran has been assessed almost 50%. It means that in consumption of nitrogen fertilizers, the extent and way of consumption should be notified carefully. Irregular consumption of nitrogen chemical fertilizers not only is economically remarkable but also because of pollution of surface and underground waters has created several difficulties [2]. The aim of tobacco cultivation is to produce leaf with more or less components of foodstuffs elements with dominant amount that could be accordant to its standard and from this point of view need for nitrogen is different in different kinds of tobacco. Required tobacco in eastern and fragrant tobacco is low, in dry-heat or flue-cured tobaccos is low to average, in Maryland tobacco is average, in barely tobacco and other tobaccos of dry weather, dry-heat, greenhouse and dry-fire is average to high [3].

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Potassium is among useful elements in most plant which is absorbed in form of ions. It is dynamic and moving in soil and plant but its mobility is between nitrogen and phosphor. Potassium which is absorbed by the plant is comparable to the extent of its required nitrogen [4]. Potassium has a positive mutual effect (synergistic) with some food elements such as nitrogen, phosphor and sulfur [2, 5]. In spite of some of necessary elements, however, potassium exists in plants in high extent, but does not participate in any organic compounds [6, 7]. In an experiment in India, effects of 3 levels of nitrogen and 3 processes of topping on performance and quality of tobacco 6534 was studied for a period of 2 years. Results of compound analysis showed that average topping has a better significant yield toward low topping or lack of topping (1992 kg/ha) and common high level of topping (1413 kg/ha). Application of 60 kg of nitrogen per hectare had a better performance over application of 40 kg of nitrogen per hectare (2098 kg/ha) [8]. Ramakishna and Krishnamorti during their studies found that there is a high and significant correlation between available potassium in surface soil (0-22.5) and potassium in tobacco leaf, while there is no significant correlation between potassium of lower soil (22.5-45) and potassium of tobacco leaf [9]. The aim of fulfillment of this experiment was to study on effects of nitrogen and potassium and access to proper fertilizer level for application in flue-cured tobacco for increasing of yield.

MATERIALS AND METHODS

In order to study on effects of nitrogen and potassium fertilizers on yield features of flue-cured tobacco Coker347 and K326, an experiment in agricultural year 2008 and 2009 with different levels of 35 (N1), 45 (N2), 55 (N3) and 65 (N4) kg of net nitrogen from urea fertilizer source and 150 (K1) and 200 (K2) kg potassium per hectare from potassium sulphat (considering the common conditions of region and recommendation of the experts) in form of factorial at Rasht Tobacco Research Institute, located at Guilan Province with longitude of eastern 49° 3' and latitude of northern 37° 16' and altitude of 25 m from sea level. Tobacco leaves in farm, gradually and during growth processes begin to ripening from under the bush. Therefore, in industrial ripening process, the leaves were harvested via 4 mows. The harvested leaves in every mow, after carrying from farm to the injecting hall, first get weighted and weight of green leaves were noted for determination of yield of green leaves. Then leaves were installed on cassettes separately from petiole and transferred to bulk curing greenhouse in order to get dried and passed 3 processes of coloring, color fixation and drying. These processes were done for the yield product from every turn in 4 mows and separately. To perform analysis of variance and comparison of means SAS software were used.

RESULTS AND DISCUSSION

Effects of nitrogen on performance of Coker 347 in first and second years in probability level of 1% have been very significant (Table 1). Also, effects of nitrogen on yield of K326 in probability level of 5% in first and second years have been significant (Table 1). Nitrogen is a structural element of amino acids, amids of nitrogen alkalis, such as purine, proteins and nucleoproteins. By increment of nitrogen amount, amount of nitrogen in plants is increased and this effect at once is occurred on solution compounds like amino acids and less on amount of protein and shows more effect of glutamic from amino acids than other amino acids influenced by improvement of nitrogen nutrition, so that amino acids are known as way of plant nutrition with nitrogen. I.e. every time glutamic acid increases, the plant has been fed with nitrogen well and vice-versa [10]. Effect of potassium on yield of Coker347 in probability level of 1% has been significant in first and second years (Table 1). Several actions which are done by potassium in botanic metabolism is reasonable via its two major qualities, first, absorption quality in huge extent selectively and second power for changing of enzymes forms [11]. Potassium plays an important role in physiological processes of plant (including opening and closing of holes and resistance in undesired environmental conditions) [12]. It is important in synthesis and transfer of carbohydrates and generally CO_2 consumption and is necessary for creation of thick cell wall. Also, it increases reaction of plant to other elements, especially to nitrogen [13]. It has been specified that potassium solved in soil, at first moves in form of spreading and mass current toward cortex cell wall spaces of root and from there moves toward vases through plasma membrane inside of the root cortex and thereof plays its vital role in plant [13]. Potassium can cause increment in number of holes in surface of leaf and its consequences are gas interchange and absorption of more CO_2 and therefore increment in photosynthesis, growth and finally increment in yield [5].

Table 1: Average Squares of Variance Analysis of the Studied Features

Changes sources	Independence Degree	Dry Leaf Yield 0f Coker347 in first year (Kg/ha)	Dry Leaf Yield 0f Coker347 in second year (Kg/ha)	Dry Leaf Yield 0f K326 in first year (Kg/ha)	Dry Leaf Yield 0f K326 in second year (Kg/ha)
Repeat	2	208310.17**	135485.79	303633/38*	161105.29
Nitrogen	3	236395.82**	272205.44**	349653/78*	381370.82*
Potassium	1	556626.04**	465930.67**	34960/67	381370.82
Nitrogen × Potassium	3	180630.93**	208714. 78*	133907/11	13113.38
Experimental Error	14	25097.74	37754.74	79702/85	81299.43

*, ** Significant at 5% and 1%, respectively

Table 2: Comparison of average simple effect of nitrogen and potassium fertilizers for the studied features

Studied Qualities	Dry Leaf Yield 0f Coker347 in first year (Kg/ha)	Dry Leaf Yield 0f Coker347 in second year (Kg/ha)	Dry Leaf Yield 0f K326 in first year (Kg/ha)	Dry Leaf Yield 0f K326 in second year (Kg/ha)
Treatments Nitrogen fertilizer				
35	1240.33b	1509.5c	1852.5a	1562.8b
45	1367.00ab	1702.3bc	1490.5b	2102.2a
55	1663.00a	2022.3a	1436.8b	2079.7a
65	1603.17a	1795.2ab	1282.2b	1992.5a
Potassium fertilizer	-	-	-	-
150	1316.00b	1618.00b	1477.3a	1910.9a
200	1620.58a	1896.67a	1553.7a	1957.7a

Also, mutual effect of nitrogen and potassium in probability level of 1% in first year and in probability level of 5% in second year on performance of Coker 347 has been significant (Table 1). Potassium in addition to aid to transfer photosynthesis products plays an essential and important role in transfer of nitrogen and its synthesis to protein. When nitrate is absorbed by plant, its negative load is neutralized by positive load of potassium and moves toward leaves together with transpiration current and transmutes into protein. In upper part of plant, potassium ion combines with Malate and again moves toward root. Malate which is transferred to root is decarboxilized and change into pyruvate and bicarbonate. Then bicarbonate is interchanged with soil nitrate and nitrate is absorbed by the plant. Therefore, potassium acts similar to nitrogen pump and improves its absorption from soil and also usage of it by the plant [14]. According to Table for comparison of average simple effect of potassium in first year, increment of application of nitrogen causes increment in performance of tobacco Coker 347. According to this table the lowest yield belong to application of levels of 35 and 45 kg/ha of nitrogen with average yields of 1240.33 and 1367 kg/ha. Treatments with application of 55 and 65 kg/ha of nitrogen with average yields equal to 1663 and 1603.17 kg/ha respectively have shown the highest performance (Table 2). According to Table for comparison of average simple effect of nitrogen in second year, consumption of 55 kg of nitrogen per hectare have shown the highest performance of tobacco Coker347 with average 2022.3 kg/ha. After that, consumption of levels of 65 and 45 kg of nitrogen per hectare with average performance of 1795.2 and 1702.3 kg/ha are respectively in next ranks. The lowest performance with average of 1509.5 kg/ha is related to 35 kg of nitrogen per hectare (Table 2). According to Table for comparison of averagesimple effect of nitrogen, consumption of 55 kg/ha has allocated the highest yield of tobacco Coker347 in both years to itself and higher consumption of it in order to prevent pollution of living environment and decrease of economical expenses is not necessary. According to Table for comparison of average simple effect of potassium, increment of yield of potassium up to the level of 200 kg/ha in both years, has increased yield of tobacco Coker347 to 304.25 and 278.67 kg/ha toward level of 150 kg/ha in first and second year, respectively (Table 2). The results of studies showed mutual effect of consumption of nitrogen and potassium on yield of tobacco Coker347 in first year that treatment 8 i.e. consumption of 65 kg/ha together with 200 kg of potassium per hectare had the highest yield in 1994 kg/ha and treatment 6 i.e. consumption of 55 kg/ha of nitrogen with 200 kg/ha of potassium also with average performance of1807 kg does not have significant difference statistically with treatment 8 i.e. consumption of 65 kg/ha of nitrogen together with 150 kg/ha of potassium with yield 1518 is placed in next class,

Table 3: Comparison of average mutual effects of nitrogen and potassium treatments for the studied features

Treatment	Nitrogen	Potassium	Dry Leaf Yield of Coker347 in first year (Kg/ha)	Dry Leaf Yield of Coker347 in second year (Kg/ha)	Dry Leaf Yield of K326 in first year (Kg/ha)	Dry Leaf Yield of K326 in second year (Kg/ha)
1	35	150	1144c	1368d	1837a	1320b
2	35	200	1337bc	1651cd	1523 ab	1805ab
3	45	150	1389bc	1731bcd	1328 ab	2090a
4	45	200	1345bc	1674cd	1526 ab	2115a
5	55	150	1518a	1977abc	1868 a	2049a
6	55	200	1807a	2067ab	1458 ab	2110a
7	65	150	1213c	1396d	1546 ab	2148a
8	65	200	1994a	2194a	1038 b	1801ab

while treatments 2, 3 and 4 with yield of 1337, 1389 and 1345 kg/ha respectively with treatment 5 and on the other land are placed with treatments 7 and 1 that the lowest yield 1213 and 1144 kg/ha in same group (Table 4). According to Table for comparison of average simple effects of potassium and nitrogen on yield of tobacco Coker347 in second year treatment 8 i.e. consumption of 65 kg/ha of nitrogen together with 200 kg/ha of potassium, has allocated the highest amount of yield to itself with average of 2194 kg/ha. Treatments 6, 5, 4, 3 and 2 respectively with averages of 2067, 1977, 1731, 1674 and 1651 kg/ha are placed in next groups. Treatments 1 and 7 respectively with averages of 1368 and 1396 kg/ha have the lowest yield (Table 3). Considering the gained results we can come to this conclusion that nitrogen and potassium fertilizers in high extent in one interaction and positive cooperation have produced thehighest yield. According to Table for comparison of average simple effect of nitrogen on tobacco K326 in first year, consumption of 35 kg of nitrogen per hectare has allocated the highest yield of tobacco K326 with average of 1852.5 kg/ha to itself and levels of 45, 55 and 65 kg/ha respectively with averages of 1490.5, 1436.8 and 1282.2 kg/ha are placed in a same group and in lower rank (Table 2). According to Table for comparison of average simple effect of nitrogen on yield of tobacco K326 in second year, levels of 45, 55 and 65 kg of nitrogen per hectare, respectively with averages of 2102.2, 2079.7 and 1992.5 kg/ha have shown the highest performance in tobacco K326 and the lowest yield was related to consumption of 35 kg of nitrogen per hectare with average of 1562.8 kg/ha (Table 2). Considering that consumption of 45 kg of nitrogen per hectare in both years with levels of 55 and 65 kg/ha of nitrogen is placed in the same group but has more yields toward two other levels. Therefore, it can be concluded that level of 45 kg of nitrogen per hectare is the maximum amount of nitrogen usable for tobacco K326 and consumption of higher levels of nitrogen is not recommended. According to Table for comparison of average simple effect of potassium, a significant difference is not observed between consumption levels of potassium in first and second years and both levels are placed in one group (Table 2). Therefore, it can be concluded that consumption of more than 150 kg of potassium per hectare is not necessary and important for tobacco K326 and is not economical. According to Table for comparison of average mutual effects of potassium and nitrogen on yield of tobacco K326 in first year, fertilizer treatment 5, i.e. consumption of 55 kg of nitrogen per hectare and 150 kg of potassium per hectare and fertilizer treatment 1, i.e. consumption of 35 kg of nitrogen per hectare and 150 kg of potassium per hectare respectively with averages of 1546, 1523, 1523, 1458 and 1328 kg/ha are placed in one group and in next rank and teatment 8 with average of 1038 kg/ha has the lowest yield (Table 3). According to Table for comparison of average mutual effects of nitrogen and potassium on performance of tobacco K326 in second year, fertilizer treatments 7, 4, 6, 3 and 5, respectively with averages of 2184, 2115, 2110, 2090, 2040 per hectare have the highest performances and all are placed in one group. Fertilizer treatments 2 and 8 respectively with averages of 1805 and 1801 kg/ha are placed in next group. Treatment 1 with average of 1320kg/ha has allocated the lowest yield to itself (Table 3).

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