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Response of Missouri and Yazdi peach seedling rootstocks to soil application of nitrogen in a nursery of Karaj, Iran

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The effect of increasing soil nitrogen fertilization as ammonium sulfate or urea was studied on surface soil variable, mineral and leaf chlorophyll content, and some growth characters (leaf surface, shoot and root length, internodes length, diameter of shoot, dry weight of shoot and root) of 2 peach seedlings rootstocks (Missouri and Yazdi) grown on nursery of seed and plant improvements institute (SPII) in Karaj in the North west of Tehran (Capital of Iran). The results of the principle component analysis (PC) corresponding to soil data of implicated soil nitrogen fertilization have shown available soil potassium (K_{ava}) was the most important parameter followed by soil phosphorus (P_{ava}). The first components were more highly correlated with the studied variables than the second components and so on. According to the results, having high available soil potassium and phosphorus was more important than adding more of nitrogen fertilizer. Height growth of both seedling rootstocks correlated positively with available soil potassium and soil phosphorus. In conclusion, fertilizing Missouri and Yazdi seedling root stocks with 200 kg/ha sulfate ammonium seems to be the promising treatments under experiment conditions.

Key words: Chlorophyll content, growth characters, Karaj, mineral and leaf surface, nursery, peach seedlings rootstocks, soil application of nitrogen.

INTRODUCTION

Statistical data of peach trees in Iran are 456.29 thousand tones for production, 28.86 thousand hectare for area harvested and averaging 158.097.00 kg ha^{-1} for yield (FAO, 2007). A nutrient survey in Iran indicated that soil texture is one of the most important limitation factors in peach orchards (Jafarzadeh and Shahbazi, 2010). Nitrogen is often the only nutrient that needs to be supplied to peach trees on a regular basis. On less fertile soils, deficiencies of Fe, Zn, B, K, Mg, Mn may develop. On peach growing areas deficiencies of P, Ca, S and Cu are rarely seen (Johnson and Uriu, 1989; Johnson, 1993). Despite evidence that soil application of nitrogen influence leave nutrient status and growth of peach cultivars (Khan, 2000; Fukuda and Kondo, 1957; Arora et al., 1999; Crisosta et al., 1997; Chatzitheodorou et al., 2004; Saenz et al., 1997) few studies examining for the establishing "most affected parameters" by nitrogen treatments have been reported. Principal component analyses (PCA) is the method that can help reveal simpler pattern within a complex set variables. This method is used for the data reduction and it is a mathematical linear transformation of the original variables, the objective of which is to account for the maximum share of the variability present in the original set of variables with a minimum number of composite variables (Hair et al., 2003; George and Malley, 2006).

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Table 1. Surface soil (0 to 20 cm) characteristics of Missouri and Yazdi seedling rootstocks grown on nursery of SPII before Soil application of nitrogen fertilizers.

Surface soil	Soil texture			EC (Ds/m)	pH	Organic matter (%)	Total neutralizing value (%)	Total N (%)	Available K (me L^{-1})	Available P {(ppm) me L^{-1}}	Available Cu (ppm)	Available Fe (ppm)	Available Mn (ppm)	Available Zn (ppm)
	Clay (%)	Silt (%)	Sand (%)											
0 - 20 cm	27	14	27	2.38	7.83	o.45	10.07	0.05	188	11	1.93	6.08	22.01	0.5

In Dahal (1996) report, it was found that principal component analysis was highly suggestive in analyzing soil test data on which a rational fertilizer nutrients recommendation can be made for a sustainable soil fertility management reign. Nargundkar (2005) has remarked that the component matrix tables show the components loadings that are the correlations between the variables and the components. This is the central output of factor or principal component analysis, which is also the basis for imputing a label to the different factors of components. It is the rule of thumb that the larger the size of the component loading for a variable, the more important the variable is in interpreting the component. The first component is generally more highly correlated with the variables than the second components and so on (Dahal, 1996). In this paper PCA, correlation, regression analysis and analysis of variance are applied to investigate the effect of soil nitrogen fertilization either as ammonium sulfate or urea on vegetative growth, mineral and leaf chlorophyll content of peach seedling rootstocks Missouri and Yazdi under nursery of SPII conditions in Karaj/Iran.

MATERIALS AND METHODS

The investigation was carried out during 2009-2010 seasons on peach seedling rootstocks (Missouri and Yazdi) grown on nursery of Seed and Plant Improvements Institute (SPPI) in Karaj/Iran. Seedlings rootstocks were spaced at10*30 cm and 500 seedlings were planted per plot. Soil application of nitrogen fertilizers was added once at end of May and repeated every 14 days. Each treatment was replied 7 times. The other cultural practices were the same for all seedling rootstocks. The experiment was arranged as a factorial arrangement of 4 N rates (0, 200, 400, and 600 kg N/ha) × 2 N sources [urea (46% N), and ammonium sulfate (26% N) × 2 peach seedling rootstocks. Chemical properties of soil at the beginning of experiment were determined following soil analysis (Drouineou, 1942; Walkley and Black, 1934; Isaac and Kerber, 1971; Olsen and Sommers, 1982). Surface soil (0 to 20 cm) variables (Total Neutralizing Value %, pH, total N%, available K Use (me L^{-1}), available P (me L^{-1}), silt %, sand %, clay %,Organic matter %, Fe ppm, Zn ppm, Cu ppm, Mn ppm, B ppm) of studied peach seedlings rootstocks before soil application of nitrogen fertilizers are presented in Table 1. The soil has low levels of organic matter and total N, high pH and relative middle levels on nutrients. PCA and Pearson correlation analysis were applied to establish the most affected parameters of soil test data by nitrogen treatments and also to study the relationship between soil test data and mineral, leaf chlorophyll content, and some growth characters (leaf surface, shoot and root length, internodes length, diameter of shoot, dry weight of shoot and root) of 2 peach seedlings studied rootstocks. The studied data were subjected to analysis of variance and the method of Duncan's was used to differentiate means. Leaf chlorophyll concentration was estimated by a SPAD-502 m (Minolta Co. Oska. Japan) in all leaves sampled. SPAD values were converted to chlorophyll concentration (µMol m^{-2}) by using the calibration equation:

$$Y= 0.15\ x2 + 1.49\ x+ 85$$

Where (Y) is the chlorophyll concentration and (X) the SPAD value in leaves Pestana et al., 2004). Leafs from each treatments were composited, oven dried and ground for chemical analysis. Nitrogen was determined by micro-Kjeldahl method (AOAC, 1980) and Potassium, Phosphorus, Calcium, Magnesium, Iron, Manganese, Zinc, Copper and Boron were determined by atomic absorption spectophotometry by atomic absorption spectophotometry (A.O.A.C, 1980). This paper would use SPSS statistic computer system to calculate the surveyed data and means were evaluated using Duncan's multiple range test at P=0.05.

RESULTS AND DISCUSSION

Principal component analysis corresponding to soil data as affected by soil application of sulfate ammonium and urea were carried out (Tables 2 and 3).

Soil-K had very high loadings with the first component accounting for 90.04% of variance while 8.6% was accounted for second component in which P content of soil had high loadings. And finally the third most important nutrient was soil Mn. As was said earlier, it is the rule of thumb that larger the size of the component loading for a variable, the more important the variable is in interpreting the component. In Dahal (1996) report, loadings above 0.6 are considered high where as those below 0.4 are low. Most common stopping rule in PCA was based on the average value of the eigenvalues >1.0 (that is, the Kaiser-Guttman criterion; Guttman, 1954; Cliff, 1988; Jackson, 1993). In this research, the eigenvalue of the first principal component was 536.654, and it explained 90.04% of the standardized variance, in which soil P and soil Mn were the major contributing variables. The correlation coefficients

Table 2. Eigen values of the Covariance Matrix using soil test data as affected by soil application of sulfate ammonium and urea.

Parameters	Eigenvalue	Difference	Proportion	Cumulative
PRIN1	536.654	485.774	0.904226	0.90423
PRIN2	50.880	47.042	0.085729	0.98996
PRIN3	3.838	2.645	0.006467	0.99642
PRIN4	1.193	0.515	0.002010	0.99843
PRIN5	0.678	0.426	0.001143	0.99958
PRIN6	0.252	0.252	0.000424	1.00000
PRIN7	0.000	0.000	0.000000	1.00000
PRIN8	0.000	0.000	0.000000	1.00000
PRIN9	0.000	0.000	0.000000	1.00000
PRIN10	0.000	0.000	0.000000	1.00000
PRIN11	0.000	0.000	0.000000	1.00000
PRIN12	0.000	0.000	0.000000	1.00000
PRIN13	0.000	0.000	0.000000	1.00000
PRIN14	0.000	0.000	0.000000	1.00000

Table 3. Eigenvectors of the three components using soil test data as affected by soil application of sulfate ammonium and urea.

Soil variable	PRIN1	PRIN2	PRIN3
TNV	0.029330	0.032694	-0.537090
soilN	0.000359	0.000315	-0.001975
Silt	0.179416	0.103268	-0.078461
OC	0.002892	0.002754	-0.008160
Ksoil	0.910388	0.182190	0.202932
Clay	0.090742	-0.017769	-0.200654
Znsoil	0.012500	-0.061851	-0.074149
Bsoil	0.004623	0.004976	-0.028526
Fesoil	-0.017538	0.034142	0.291395
Psoil	-0.232838	0.920275	0.126703
Mnsoil	-0.032465	-0.306478	0.539130
pH	-0.000860	0.005576	-0.045688
Cusoil	0.005362	0.021401	0.062203
Sand	-0.272092	-0.086173	0.319911

for soil test data and positive significant correlation with their regression equations for mineral and leaf chlorophyll content, and some growth characters of Missouri and Yazdi seedling rootstocks as affected by soil application of sulfate ammonium and urea in Tables 4 and 5. High values of soil K (the first most important nutrient) were related with high rate of total soil N in the surface, TNV, OC, as recently reviewed by Dahal et al. (1996). We have found also high values of soil K soil are related with high rate of Zn, and soil B and also, the amount of silt and clay in soil (Table 4).

The first component is generally more highly correlated with the variables than the second components and so on (Dahal, 1996). In agreement with this, we have found soil K (the first component) was generally more highly correlated with the variables than the other components Leaf K and leaf Mg content of Missouri seedling rootstocks have been observed to be positively correlated with soil K. The high values of soil P (the second most important nutrient) are related with high rates of leaf Cu content, dry weight of shoot, root length and diameter of shoot for Missouri seedling rootstocks. High values of soil Mn (the third most important nutrient) were related with high rate of leaf Zn and leaf Fe of this peach seedlings rootstocks (Table 5). It has been observed that dry weight of root and shoot length of Yazdi seedling rootstocks was positively correlated with soil K. Soil P were positively correlated with leaf p, K, Zn, Cu concentration of Yazdi

Table 4. Pearson correlation coefficient between soil test data as affected by soil application of sulfate ammonium and urea.

Correlation	TNV	Total soil N	Silt	OC	K_{soil}	Clay	Zn_{soil}	B_{soil}	Fe_{soil}	Ec_{soil}	P_{soil}	Mn_{soil}	pH	Cu_{soil}	Sand
TNV	1	0.77**	0.54*	0.63**	0.49*	0.67**	0.63**	0.63**							
Total soil N		1	0.86**	0.90**	0.79**	0.88**	0.38*	0.80**					0.48*	0.49*	
Silt			1	0.97**	0.97**	0.91**	0.42*	0.72**						0.45*	
OC				1	0.92**	0.88**	0.37*	0.76**						0.42*	
K_{soil}					1	0.94**	0.43*	0.74**							
clay						1	0.5*	0.85*							
Zn_{soil}							1					0.45*			
B_{soil}								1							
Fe_{soil}									1	0.64**	0.54*				
Ec_{soil}										1				0.62**	
P_{soil}											1				
Mn_{soil}												1			0.41
pH													1	0.53*	
Cu_{soil}														1	
Sand															1

* Only positive coefficients significant are presented.

Table 5. Correlation analysis and their regression equations for soil test data, mineral and leaf chlorophyll content, and some growth characters of Missouri and Yazdi seedling rootstocks as affected by soil application of sulfate ammonium and urea.

Missouri seedling rootstocks		
Y=Leaf N	Y=0.73Soil Fe+0.07	r =0.40*
Y=Leaf P	Y=0.07Leaf K+0.08	r 0.71**
	Y=4.11Leaf Ca-0.11	r 0.69**
	Y=0.56LeafMg-0.04	r 0.78**
	Y=1.56Total soil N +0.15	r =0.46*
	Y=0.28OC +0.10	r 0.57**
	Y=0.004Silt+0.08	r =0.48*
Y=Leaf K	Y=0.70Leaf Ca +1.04	r =0.44*
	Y=3.71Leaf Mg -0.003	r =0.53*
	Y=0.01Ksoil+0.43	r=0.49*
Y=Leaf Ca	Y=2.44Leaf Mg 0.28	r 0.56**
	Y=0.05Leaf Zn +0.02	r =0.40*
Y=Leaf Mg	Y=3.22TotalsoilN +0.32	r 0.68**
	Y=0.001SoilK+0.27	r=0.47*
	Y=0.15SoilB-0.38	r=0.43*
	Y=0.02TNV+0.22	r=0.54*
	Y=0.46 9OC+0.28	r=0.68**
	Y=0.01Clay+0.19	r=0.45*
	Y=0.01Silt+0.21	r=0.60**

Yazdi seedling rootstocks		
Y=Leaf P	Y=0.038Leaf Zn-.0.37	r=0.55**
	Y=0.09dwr+0.10	r=0.35*
	Y=0.08dws-0.03	r=0.59**
	Y=0.014P soil-0.03	r=0.65**
	Y=0.19Cu soil-0.04	r=0.41*
Y=Leaf K	Y=0.61Leaf Ca+0.58	r=0.39*
	Y=12.06P soil+6.19	r=0.42*
	Y=8.90Sand+33.92	r=0.41*
Y=Leaf Ca	Y=1.62Soil Fe+4.63	r=0.35*
Y=Leaf Zn	Y=1.10Leaf Cu+6.07	r=0.75**
	Y=0.16Leaf Mn+3.45	r=0.51*
	Y=0.43root length+5.19	r=0.57**
	Y=1.75dwr+11.05	r=0.44*
	Y=1.36dws+9.36	r=0.64**
	Y=1.64EC-soil+11.02	r=0.50*
	Y=10.17P soil+10.32	r=0.55**
	Y=1.41Fe soil+4.96	r=0.47*
	Y=2.85Cu soil+9.29	r=0.43*
Y=LeaCu	Y=0.11Leaf Mn+0.43	r=0.48*
	Y=0.29Root length+1.2	r=0.56**
	Y=1dwr+5.42	r=0.37*
	Y=0.89dws+4.08	r=0.62**

Table 5. Contd.

Y= Leaf Fe	Y=17.88SoilMn+116.01	r=0.42*
Y= Leaf Zn	Y=0.11Sand+8.73	r=0.46*
	Y=0.10shoot length+9.85	r=0.40*
	Y=0.09Leaf Mn+7.5	r=0.48*
Y= Leaf Cu	Y=0.12 SoilP+4.62	r=0.59**
	Y=0.77SoilFe+2.21	r=0.40*
	Y=0.12 Sand+1.9	r=0.44*
Y=Leaf-Chlorophyll	Y=4.65TNV+58.23	r=0.42*
	Y=2.20dws +86.24	r=0.67**
	Y=7.58dwr+83.6486.811.69	r=0.38*
	Y=1.04Stem length+64.23	r=0.52*
		r=0.42*
	Y=5.32Diameter of shoot+95.65	r=0.53*
Y=Stem -diameter	Y=0.03 Psoil+0.99	r=0.41*
	Y= 0.31 dwr+0.79	r=0.57**
	Y=0.11 dws+0.75	r=0.67**
Y=dry weight of stem	Y=0.21Psoil+3.99	r=0.43*
	Y=3.11dry weight of root-0.26	r=0.92**
	Y=0.28Shoot length-2.38	R=0.52*
Y=Root length	Y=0.22Psoil+19.44	r=0.47*
	Y= 2.33 ds+20.17	r=0.38*
	Y= 1.36 dwr+20.25	r=0.41*
	Y= 0.42 dws+20.51	r=0.42*
Y=Stem length	Y=0.28 dwr+0.47	r=040*
	Y=0.65dws+33.07	r=0.42*
Y=Dry weight of root	Y=0.86Internode+0.59	r= 0.57**
	Y=0.085Stem length-0.21	r=0.40*
	Y=0.12rooth length-0.21	r=0.41*
	Y=1.06Diameter of stem+0.996	r=57**
	Y=0.27 dws+0.47	r=0.92
Y=Internodes	Y=0.76Diameter of stem+1.25	r=0.57**
	Y= 0.05shoot length+0.50	r=0.38*
	0.14Psoil+4.03	r=0.69**
Y=Leaf Mn	Y=1.76 rootlength+30	r=0.72
Y=Leaf B	Y=4.81Fe soil+1.07	r=0.48*
	Y=1.66Mnsoil+9.19	r=0.49*
Y=Leaf chlorphyll	Y=0.77TNV+0.48	r=0.48*
	Y=1.98Zn soil+89.04	r=0.35*
Y=Root length	Y=2.77dwr+15.54	r=0.53*
	Y=1.16dws+16.05	r=0.42*
	Y=1.92EC soil+16.61	r=0.45*
Y=Internodes	Y=1.72.DS+0.02	r=0.52*
	Y=0.15TNV+0.10	r=0.36
	Y=20.48Soil N+0.96	r=0.38
	Y=1.98B soil+0.97	r=0.51
Y=Diameter of stem	Y=0.02shoot length+0.4	r=0.39*
	Y=0.06TNV+0.38	r=0.45*
	Y=0.95OC+0.64	r=0.41*
	Y=6.75SoilN+0.74	r=0.41*
	Y=0.03Clay+0.33	r=0.35*
	Y=0.01Silt+0.50	r=0.35
Y=Stem length	Y=18.32OC+21.75	r=0.38*
	Y=1112.2Soil N+24.14	r=0.33*
	Y=0.06K soil+9.18	r=0.35*
	Y=0.52clay+15.77	r=0.32*
	Y=0.31Silt+17.70	r=0.37*
	Y=7.97B soil+25.10	r=0.33*
Y=dwr	Y=0.45Ec soil+0.80	r=0.55**
	Y=6.69OC+0.64	r=0.75**
	Y=35.20Soil N+0.41	r=0.57**
	Y=0.02K soil-1.80	r=0.75**
	Y=0.17Clay-2.45	r=0.59**
	Y=0.12Silt-2.29	r=0.78**
	Y=0.92Cu soil+0.11	r=0.55**
	Y=2.12B soil+0.85	r=0.47*
Y=dws	Y=0.60EC soil+2.21	r=0.40*
	Y=0.05P soil+2.22	r=0.35*
	Y=1.09Cu soil+1.49	r=0.35*

Table 5. Contd.

	Y= 0.43 dwr+1.29	r=0.61**				
	Y= 0.12 dws+1.49	r=0.57**				

* Only positive coefficients significant are presented. dwr=dry weight of root, dws=dry weight of shoot, TNV=total neutralizing value DS=diameter of shoot, OC= organic matter.

Table 6. Mineral and leaf chlorophyll content and vegetative growth of Missouri and Yazdi seedling rootstocks as affected by soil application of sulfate ammonium and urea.

Soil fertilization	Missouri seedling rootstock																		
	Mineral and leaf chlorophyll content											Vegetative growth							
	N(%)	P(%)	K(%)	Ca(%)	Mg(%)	Fe(ppm)	Zn(ppm)	B(ppm)	Cu(ppm)	Mn(ppm)	Chl.* (µMol m−2)	Root length (cm)	Internodes (cm)	Shoot diameter (cm)	Leaf surface (cm2)	Stem length (cm)	Dry weight of shoot (g)	Dry weight of root (g)	Leaf surface (cm2)
Control	4.24B	0.21BAC	2A	0.69A	0.46A	634.75BA	11.8C	40A	5.43B	62.28A	100.05E	22BC	1.33C	0.83B	4.65A	27.67C	2.37C	1.21C	4.63A
200 kg/ha Sulfate ammonium	3.95B	0.25A	1.76BA	1.01A	0.47A	396.50E	13.15BC	25B	7.67BA	65.33A	132.17A	27.33BA	3.17BA	2.5A	5.66A	40.33BA	14.35A	4.15A	5.66A
400 kg/ha Sulfate ammonium	5.37B	0.22BA	1.61BAC	0.87A	0.47A	456.65DCE	15.55A	40A	8.03BA	75.05A	103.12D	23.33BAC	2.23BC	1.67BA	6.91A	41BA	7.74B	2.30BC	6.913A
600 kg/ha Sulfate ammonium	7.60A	0.16D	1.51BC	0.68A	0.39B	547.18BC	12.88BC	27.5B	6.98BA	62.80A	104.28D	29A	2.25BC	1.40B	7.81A	40.67BA	8.18B	2.78BAC	7.81A
200 Kg/ha urea	3.75B	0.19BDC	1.6BAC	0.78A	0.45A	433.98DE	14.58BA	37.5A	6.08B	60.88A	116.19B	22.33BC	3.17BA	1.67BA	5.86A	44.67A	9.44B	3.71BA	5.86A
400 kg/ha urea	3.78B	0.17DC	1.21C	0.65A	0.39B	687.63A	12.95BC	37.5A	5.78B	67.58A	98.20F	20C	3.33A	1.83BA	7.32A	35BC	8.61B	2.87BAC	7.32A
600 kg/ha urea	3.67B	0.1667D	1.35BC	0.64A	0.36B	525.68DC	14.45BA	42.5A	9.07A	66.7A	106.14C	23.67BAC	1.83C	1.5BA	6.81A	39.67BA	6.762BC	2.04BC	6.81A

Soil fertilization	Yazdi seedling rootstock																	
	Mineral and leaf chlorophyll content											Vegetative growth						
	N(%)	P(%)	K(%)	Ca(%)	Mg(%)	Fe(ppm)	Zn(ppm)	B(ppm)	Cu(ppm)	Mn(ppm)	Chl.* (µMol m−2)	Root length (cm)	Internodes (cm)	Shoot diameter (cm)	Shoot length (cm)	Dry weight of shoot (g)	Dry weight 0f root (g)	Leaf surface (cm2)
Control	3.88C	0.21B	0.85B	0.93BA	0.43A	459.2DE	14.78BA	35B	6.75B	62.18B	87.92E	22.67BA	1.67A	1A	30.33A	4.25BA	2.79A	6.77A
200 kg/ha Sulfate ammonium	4.29BAC	0.63A	1.30BA	1.03BA	0.57A	481.18DE	15.08BA	17.5D	9.13A	67.33BA	89.66D	19.67BDC	1.83A	1A	29.33A	4.42A	1.92B	6.04A
400 kg/ha Sulfate ammonium	4.08BC	0.24B	1.32BA	0.88BA	0.56A	441.18E	16.13A	25CD	8.67A	66.67BA	92.04B	21.67BAC	2A	1A	27A	3.40BAC	1.48CB	6.28A
600 kg/ha Sulfate ammonium	4.47BA	0.25B	1.1BA	1.12BA	0.45A	1173.50A	16.05A	30CB	8.25A	77.47A	87.67E	24A	1.33A	0.92A	28.33A	3.72BA	1.42CBD	6.22A
200 Kg/ha urea	4.57A	0.12B	0.95B	0.80B	0.50A	814.45B	10.53C	22.5CD	5.13C	61.38B	93.75A	18DC	1.6A	1A	27.33A	1.80C	1.09CD	6.35A
400 kg/ha urea	4.34BA	0.13B	1.49A	1.16A	0.55A	561.50C	11.05C	30CB	5.18C	61.43B	89.35D	16D	1.83A	1.08A	27A	2.67BAC	1.20CD	8.03A
600 kg/ha urea	4.19BAC	0.15B	1.26BA	1.01BA	0.51A	520.88DC	12.60BC	42.5A	5.6CB	55.93B	90.94C	16.67D	1.07A	0.67B	24.67A	2.38BC	0.90D	6.61A

Means having the same letter(s) within a column are not significantly different at 5% level.

seedling rootstocks. High values of soil Mn were related with high rate of leaf B of these peach seedlings rootstocks (Table 5). Normally, nitrogen fertilization had a significant effect on the nitrogen concentration in the leaves of some fruit trees (Rufat and Dejong, 2001; Sakalauskaite et al., 2008**)** but no significant correlation was found between nitrogen concentration in the leaves of Missouri and Yazdi seedling rootstocks and total soil nitrogen.

These results of correlation analysis and principal component analysis, together with the comparisons of mineral and leaf chlorophyll content and vegetative growth of Missouri and Yazdi seedling rootstocks as affected by soil application of sulfate ammonium and urea (Table 6) indicated that increasing soil nitrogen fertilization were not always well supplied, and, in some cases, the low application of nitrogen fertilizers in soil may increased growth characters and leave nutrient status of studied peach seedling rootstocks.

Some authors have indicated that in many cases it may be desirable to use lower soil application of nitrogen fertilizers to ensure good rootstocks growth in nurseries (Knight, 1973; Tagliavini et al., 1996; Will, 1971; Cheng and Fuchigami, 1997; Xie and Cummings, 1995). In the present study, application of 200 kg/ha sulfate ammonium to Missouri and Yazdi seedling rootstocks resulted in the highest leave P, Mg, and Cu concentration, leaf surface and some growth characters (shoot length, internodes, diameter of shoot, dry weight of shoot) of both studied peach seedling rootstocks. The principal component analysis has proved to be an exceeding popular technique for dimensionality reduction (Tripping and Bishop, 1999). Nitrogen (N) is the most important soil nutrient (Daha, 1996). However, in this paper, the result of PCA has shown the most affected parameters by soil nitrogen fertilization either as ammonium sulphate or urea on of peach seedling rootstocks Missouri and yazdi (under nursery of SPII conditions in Karaj/Iran) are soil K parameter followed by soil P.

Conclusions

Our results has shown the most affected parameters as affected by soil nitrogen fertilization either as ammonium sulphate or urea for both studied peach seedling rootstocks under nursery of SPII conditions in Karaj/Iran are soil K parameter followed by soil P. According to the results, having high available soil potassium and phosphorus was more important than adding more of nitrogen fertilizer. Application of 200 kg/ha sulfate ammonium to Missouri and Yazdi seedling rootstocks resulted in the highest leave P, Mg, and Cu concentration, leaf surface and some growth characters (shoot length, internodes, diameter of shoot, dry weight of shoot) of both studied peach seedling rootstocks.

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