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Nitrogen use effectiveness and life cycle of root knobs in Alfalfa after various mineral treatment and soil development

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Abstract— Nitrogen use productivity and life cycle of root knobs in horse feed after various mineral treatment and soil development practices were examined. Field preliminary was directed in the Organization of Scrounge Yields, Pleven, Bulgaria on filtered chernozem subsoil type and no water system. The following medicines were tried: I) for preparation as pursues: N0P0K0 (control); N60P100K80 (an acknowledged innovation); N23P100K35 (nitrogen was connected 1/2 in first year of developing and 1/2 in third year); N23P100K35 (nitrogen was provided pre-planting); N35P80K50, and Amophose - 250 kg/ha, determined at treating rates N27P120K0; ii) for soil development as pursues: soil losing 10-12 cm, furrow at profundity 12-15 cm, 22-24 cm (an acknowledged innovation), 18-22 cm and 30-35 cm. It was discovered that dirt development and mineral preparation had impact on nitrogen use productivity and life cycle of root knobs in Hay. Nitrogen use effectiveness was observed to be most astounding at N23P100K35 and furrow at the profundity of 22-24 cm. Life cycle of root knobs was the longest at N35P80K50 and furrow at the profundity of 18-22 cm. The better root mass to knob number proportion was found at N23P100K35 and furrow at the profundity of 22-24 cm.

Keywords— Alfalfa; Life cycle of root nodules; Mineral fertilization; Nitrogen use efficiency; Soil cultivation.

1. Introduction

Application of synthetic nitrogen fertilizers in agriculture is essential for crop productivity (Tilman et al., 2002, Mueller et al., 2012, Sinclair and Rufty, 2012). They are a part of "green revolution" after which although not enough, but the plant protein has to be found increasing (Lassaletta et al., 2014a). However, at present most of the half of nitrogen used for fertilization is lost to the environment. For most of Europe, the losses are above 50 kg N ha/yr. This conclusion was done after extensive survey on nitrogen use efficiency (applied to the crops as synthetic fertilizers, manure, symbiotic nitrogen fixation and atmospheric deposition). This study was done on the base of FAO data and 124 counties were involved (Power and Alessi, 1971; Tilman et al., 2002; Herridge et al., 2008; Bouwman et al., 2009). Results showed that nitrogen use efficiency was generally higher for agricultural systems with higher proportion of N inputs derived from symbiotic nitrogen fixation. Conversely, nitrogen use efficiency was generally lower for a higher proportion of synthetic fertilizers in total fertilization scheme. The higher nitrogen use efficiency associated to nitrogen fixation is likely explained by a higher efficiency in the incorporation by legumes of their self-supplied nitrogen (Herridge et al., 2008).

Despite the fact that significant improvement in nitrogen use proficiency has happened in numerous nations, an expansion of nitrogen treatment would bring about a lopsidedly low increment of harvest generation with further natural changes (Lassaletta et al., 2014b). Utilizing nitrogen contributions with low productivity prompts natural issues, for example, contamination of groundwater by nitrates, alkali outflows and ozone depleting substances. In this way, the effectiveness of asset use is essential and its improvement is the key test for manageable farming. Gainful, and yet earth and socially maintainable, agro-biological systems are required. Appropriate plans of preparation and soil development practices are among the components that are significant for nitrogen and phosphorus use effectiveness improvement. An expansion of nitrogen fixing potential as a wellspring of nitrogen can likewise add to expanding nitrogen use proficiency at the nearby and worldwide scale (Herrero et al., 2010, Lassaletta et al., 2014a, Bonaudo et al., 2014, Soussana and Lemaire, 2014). Phosphorus is the second most crucial plant supplement separated from nitrogen, however for vegetables, it presumes essential noteworthiness which assumes a significant job in root multiplication (Tairo and Ndakidemi, 2013). Richardson and Berea (2009) announced that development, yield and yield segments in vegetables improved essentially by sufficient supply of phosphorus. One of the most significant search vegetable species is Horse feed (Medicago sativa L.). It has a place with request Family Fabaceae, sort Medicago. The acknowledged name is Medicago sativa L. It is a significant protein hotspot for creatures with high nutritive worth and wealthy in minerals (Barnes et al., 1995; Kertikova, 2008; Keskin et al., 2009). As a legumeAlfalfa is nitrogen fixing crop and the potential for nitrogen obsession through beneficial interaction is around 450 kg/ha/year (Heichel and Henjum, 1991; Starchenkov and Kot's, 1992).

The issue of the extra acquaintance of nitrogen with Hay and how the nitrogen use productivity will be, is easily proven wrong in the writing (Oliveira et al., 2004; Werner and Newton, 2005). Numerous creators bolster the proposal for use of nitrogen preparation (Cihacek, 1994; Petkova, 1994; Sharma and Sharma, 1995; Butorac et al., 1988; Raun et al., 1999; Trepachev, 1999; Delgado et al., 2001; Pachev, 2001; Tufenkci et al., 2006; Vasileva et al., 2006; 2011; Vasileva and Ilieva, 2011). The need of nitrogen preparation was affirmed by Raun et al. (1999). They found an extra applying of nitrogen compost (once in the spring) improved dry mass efficiency in the cuts, gathered later, which is in accordance with declined then nitrogen obsession limit. In a similar time, high dosages of mineral nitrogen repress the natural obsession process (Streeter, 1985a, b; Kot's et al., 1990, 1996; Streeter, 1993; Kot's, 2001; Vasileva, 2004). The point of this work was to contemplate the nitrogen use productivity and life cycle of root knobs after various mineral treatment and soil development rehearses in Horse feed.

This examination has been performed in the Organization of Scrounge Harvests, Pleven, Bulgaria in 2003-2006.

2. MATERIALSAND METHODS

The investigation was done in the trial field of the Foundation of Scavenge Harvests, Pleven, Bulgaria (2003-2006) on filtered chernozem soil subtype without water system. Horse feed assortment Obnova 10 was planted. Long plot strategy was utilized and plots size was 10 m2. The medicines being 4-times recreated were: I) for treatment as pursues: N0P0K0(control); N60P100K80 (by acknowledged innovation); N23P100K35 (nitrogen was connected 1/2 in first year of growing, 1/2 in third year, and P and K supply); N23P100K35 (nitrogen was provided pre-planting, K supply, P by 1/3 in the primary, second and third year of developing); N35P80K50, and Amophose - 250 kg/ha, determined at preparing rates N27P120K0; ii) for soil development as pursues: soil losing 10-12 cm, furrow at profundity 12-15 cm, 22-24 cm (an acknowledged innovation), 18-22 cm and 30-35 cm. Most significant agrochemical attributes of the dirt (dictated by Page et al., 1982), were as per the following: N, 31.5/1000 g soil; P (P2O5), 5.19 mg/ 100 gsoil;K (K2O), 25.4 mg/100 g soil; pH (H2O), 6.95; humus, 1.77%.

One cut in the primary exploratory year and two cuts in the following three years were reaped. Nitrogen use proficiency (NUE) (kg/kg) was determined utilizing formulae of Bowen and Zapata (1991) and Yousefi and Mohammadi (2011), condition no. 1. Phosphorus use productivity (PUE) (kg/kg) was determined utilizing formulae of Bowen and Zapata (1991), condition No. 2:

NUE = dry mass yield (kg/ha)/nitrogen applied (kg/ha) (1)
PUE = dry mass yield (kg/ha)/phosphorus applied (kg/ha) (2)

Soils from soil profile were taken (20/30/40 cm). Root mass was washed with faucet water and estimated (Beck et al., 1993): span of the existence cycle of root knobs – recorded based on inside shading (days) (Milev, 2014), roots to number of root knobs proportion was determined (g roots/number root knobs) - dry root mass, dried at 60oC was isolated to number of root knobs. Exploratory information was arrived at the midpoint of for the time of study and factually handled utilizing SPSS programming program (2012).

3. RESULTS AND DISCUSSION

Agro meteorological conditions for the time of concentrate were negative (Table 1). Drawn out dry season period happened in the main year. Late-winter dry spell just as unevenly disseminated precipitation happened in the second test year. The third year was resolved as great (with more and equally dispersed precipitation). Rare precipitation and dry season denoted the most recent year. Nitrogen use proficiency is an agronomical parameter speaking to the proportion between yield got and nitrogen connected. Results demonstrated more prominent nitrogen use effectiveness for low dosages of nitrogen treatment, where nitrogen admission was better (Table 2). Hartwig and Soussana (2001) found that Hay utilized the dirt or compost nitrogen during the underlying advancement of the plants, since nitrogen osmosis needs lower levels of CO2 and vitality when contrasted with nitrogen obsession process, along these lines requires applying nitrogen. Vasileva and Pachev (2015) propose that the essential improvement of Hay plants need nitrogen to keep away from the maintenance of root advancement. Justes et al. (2001) thought about that Horse feed plants without nitrogen preparation had an essentially lower root dry mass than plants with nitrogen treatment.

There were little contrasts in nitrogen use productivity at N23P100K35, in spite of the fact that nitrogen was connected in various ways (1/2 in first year of growing, 1/2 in third year or pre-planting). Generally greater contrasts were found for the shallowest and most profound soil furrowing. For various soil development profundities, the nitrogen use proficiency for N23P100K35 could be organized in diminishing request as pursues: furrow at the profundity of 22-24 cm, soil loosing at the profundity of 12-15 cm, furrow at the profundities 12-15, 30-35 and 18-22 cm. The yield reactions to N expansion could be restricted by uneven characters with different supplements, for example, phosphorus (van der Velde et al., 2014).

Phosphorus is significant for over-the-ground and root mass developing of Horse feed. It assumes a key job for the knob parameters, for example, number, size and action (Armstrong, 1999). Vasileva and Pachev (2009) and Jing-Wei Fan (2015) found both higher nodulation capacity and dry mass profitability in Hay plants which were better

Table 1: Agro meteorological conditions for the period of study

Months	First year		Second year		Third year		Fourth	
	t	rainfall	t	rainfall	t	rainfall	t	rainfall
	°C	l/m2	°C	l/m2	°C	l/m2	°C	l/m2
I	-0.1	53.4	-2.2	26.1	2.4	55.0	-2.9	8.8
II	-3.4	27.6	3.2	23.9	-1.7	46.3	0.6	121.0
III	4.7	10.2	7.4	41.6	5.1	75.8	6.8	176.0
IV	10.9	83.6	13.1	6.9	12.4	57.4	13.2	30.9
V	20.5	74.5	16.1	87.5	17.5	101.0	17.8	33.2
VI	23.9	12.8	20.3	70.3	19.8	95.9	21.0	47.3
VII	23.7	49.7	23.5	38.5	22.6	115.0	23.0	78.4
VIII	25.5	1.4	22.6	82.4	21.4	156.0	23.2	63.4
IX	17.7	67.6	18.4	42.2	17.4	225.0	18.7	48.5
X	10.7	107.0	14.0	14.6	17.4	25.5	17.4	25.5
XI	7.4	24.8	7.9	21.6	5.1	24.0	5.1	24.0
XII	1.2	28.2	2.6	43.3	2.7	41.7	3.3	32.5

Table 2: Nitrogen use efficiency of Alfalfa after different fertilizing rates and soil cultivation

Treatments	Soil loosing	Plough			
	12-15 cm	12-15 cm	22-24 cm	18-22 cm	30-35 cm
	kg/kg				
N60P100K80	67.33	72.17	78.17	61.83	70.67
N23P100K35*	210.00	196.09	210.87	182.61	203.91
N23P100K35**	208.26	209.13	208.26	188.26	194.35
N35P80K50	126.00	117.43	127.43	120.00	110.00
Amophose	161.11	155.56	167.41	155.93	156.30
SE (P=0.05)	26.8	25.3	25.2	23.3	25.4
max	210.00	209.13	210.87	188.26	203.91
min	67.33	72.17	78.17	61.83	70.67

* nitrogen was applied 1/2 in first year of growing, 1/2 in third year, and P and K supply

** nitrogen was supplied pre-sowing, K supply, P by 1/3 in the first, second and third year of growing

Nitrogen use efficiency and life cycle of nodules in alfalfa

Table 3: Phosphorus use efficiency of Alfalfa after different fertilizing rates and soil cultivation

Treatments	Soil loosing	Plough			
	12-15 cm	12-15 cm	22-24 cm	18-22 cm	30-35 cm
	kg/kg				
N60P100K80	40.40	43.30	46.90	37.10	42.40
N23P100K35*	48.30	45.10	48.50	42.00	46.90
N23P100K35**	47.90	48.10	47.90	43.30	44.70
N35P80K50	55.13	51.38	55.75	52.50	48.13
Amophose	36.25	35.00	37.67	35.08	35.17
SE (P=0.05)	3.30	2.75	2.88	3.03	2.29
max	55.13	51.38	55.75	52.50	48.13
min	36.25	35.00	37.67	35.08	35.17

* nitrogen was applied 1/2 in first year of growing, 1/2 in third year, and P and K supply

** nitrogen was supplied pre-sowing, K supply, P by 1/3 in the first, second and third year of growing

Table 4: Duration of the life cycle of root nodules of Alfalfa after different fertilizing rates and soil cultivation

Treatments	Soil loosing	Plough			
	12-15 cm	12-15 cm	22-24 cm	18-22 cm	30-35 cm
	days				
N0P0K0	34.1	32.2	34.2	38.4	36.0
N60P100K80	39.1	37.0	35.4	39.0	39.2
N23P100K35*	35.4	38.6	39.5	38.8	37.3
N23P100K35**	36.3	33.7	38.6	40.2	39.8
N35P80K50	35.0	34.6	35.8	41.6	38.3
Amophose	34.5	37.4	35.6	41.4	39.6
SE (P=0.05)	0.74	1.00	0.84	0.56	0.60
max	39.1	38.6	39.5	41.6	39.8
min	34.1	32.2	34.2	38.4	36.0

* nitrogen was applied 1/2 in first year of growing, 1/2 in third year, and P and K supply

** nitrogen was supplied pre-sowing, K supply, P by 1/3 in the first, second and third year of growing

Table 5: Root mass to nodule number ratio in Alfalfa after different fertilizing rates and soil cultivation

Treatments	Soil loosing	Plough			
	12-15 cm	12-15 cm	22-24 cm	18-22 cm	30-35 cm
		g roots/number root nodules			
N0P0K0	2.6214 (4.58/1.8)	0.7608 (4.56/6.0)	0.5462 (4.64/8.5)	0.6756 (5.74/8.5)	0.6758 (5.23/7.8)
N60P100K80	0.9690 (5.08/5.3)	0.6387 (4.95/7.8)	0.5344 (4.81/9.0)	0.6703 (5.69/8.5)	0.4759 (5.23/11.0)
N23P100K35*	2.4857 (4.35/1.8)	0.5046 (4.41/8.8)	0.4288 (5.14/12.0)	0.6732 (5.72/8.5)	0.6746 (5.90/8.8)
N23P100K35**	2.2089 (4.97/2.3)	0.9150 (4.57/5.0)	0.5092 (4.96/9.8)	0.6850 (5.82/8.5)	0.5498 (5.91/10.8)
N35P80K50	2.2422 (5.04/2.3)	0.9895 (4.94/5.0)	0.6144 (5.53/9.0)	0.6897 (6.55/9.5)	0.6568 (6.07/9.3)
Amophose	1.6438 (5.34/3.3)	0.6213 (4.81/7.8)	0.7348 (5.69/7.8)	0.6514 (5.70/8.8)	0.7315 (6.03/8.3)
SE (P=0.05)	0.2523	0.0007	0.0004	0.0005	0.0003
max	2.6214	0.9895	0.7348	0.6897	0.7315
min	0.9690	0.5046	0.4288	0.6514	0.4759

* nitrogen was applied 1/2 in first year of growing, 1/2 in third year, and P and K supply
** nitrogen was supplied pre-sowing, K supply, P by 1/3 in the first, second and third year of growing
In the brackets - (root mass/root nodule number)

provided with phosphorus. Information in the Table 3 demonstrated that phosphorus use proficiency was observed to be higher for lower portions of phosphorus treatment and the other way around. Therefore, the phosphorus use productivity for all profundities of soil development was the most elevated at the portion of treatment N35P80K50. It differed in a moderately restricted cutoff point for the rest trial portions, where the supply with phosphorus was 100 kg/ha. Phosphorus use effectiveness was the most astounding at the furrow at the profundity of 22-24 cm and N35P80K50. Cooperative obsessions of nitrogen occur in the root knobs (Serraj et al., 1999). Pink hued and situated on the fundamental root knobs are sign for their adequacy (Beck et al., 1993; Athar and Johnson, 1996; Athar and Shabbir, 1997; Kostov and van Cleemput, 1997). Life cycle span of root knobs is significant for the typical working of these structures and fixing of more nitrogen also. Milev (2014) found the estimation of this file in pea was legitimately relative to the vegetation precipitation during the year and the length was somewhere in the range of 30 and 52 days. Life cycle term of root knobs in this examination differed somewhere in the range of 32.2 and 41.6 days (Table 4). Length of life cycle of root knobs was the most reduced in the control. The longest term of 39.1 days was found at the shallow soil development and higher nitrogen supply (N60P100K80). Longer life cycle of root knobs was seen in the plants all around provided with phosphorus (for the furrow at the profundities of 22-24, 18-22 and 30-35 cm). The discoveries of Asuming-Brempong et al. (2013) were comparable for cowpea. Having at the top of the priority list the attributes incorporated into the estimation of root mass to knob number proportion, lower estimations of this proportion showed better arrangement of root mass with root knobs (Table 5). The better protection of root mass with root knobs was found at N23P100K35 (nitrogen was connected 1/2 in first year of growing, 1/2 in third year) and furrow at the profundity of 22-24 cm. Nitrogen use productivity and the better root mass to knob number proportion in Hay was observed to be most astounding at N23P100K35 (nitrogen was connected 1/2 in first year of growing, 1/2 in third year) and furrow at the profundity of 22-24 cm. Development rate also biomass yield of hay must be examined more detail. High caliber of scavenge in the wake of preparing with rates N35P80K50 was found by Naydenova and Pachev (2009).

4. Conclusion

Soil cultivation and mineral fertilization had effect on nitrogen use efficiency and life cycle of root nodules in Alfalfa. Nitrogen use efficiency was found to be highest at N23P100K35 (nitrogen was applied 1/2 in first year of growing, 1/2 in third year) and plough at the depth of 22-24 cm; and the phosphorus use efficiency was the highest at the same depth of soil cultivation and N35P80K50. Life cycle of root nodules was the longest at N35P80K50 and plough at the depth of 18-22 cm. The better root mass to nodule number ratio was found at N23P100K35 (nitrogen was applied 1/2 in first year of growing, 1/2 in third year) and plough at the depth of 22-24 cm.

5. CONFLICT OF INTEREST

The creators announce that there are no irreconcilable situations in regards to the production of this composition.

6. References

[1] Armstrong, D.L., (1999). Better crop, vol 83. Potash & Phosphate Institute, 655 Engineering Drive, Suite 110, Norcross, GA 30092-2837.pp 1-30 (30 Pages).

[2] Asuming-Brempong, S., (2013). Wiafe Y., Aggrey Martin K. Nodulation of cowpea (Vignaunguiculat [L]walp) at different levels of phosphorus in a Typic Kandiustalf. Agric. Sci. Res. J., 3 (12): 387-394 (8 Pages).

[3] Athar, M.; Johnson D., (1996). Nodulation, biomass production and nitrogen fixation in alfalfa under drought. Journal of Plant nutrition, 19: 185-199 (15 Pages).

[4] Athar, M.; Shabbir S. M., (1997). Nodulation characteristics of some of the forage and browse legumes. Phytologia, 82: 12-19 (10 Pages).

[5] Barnes, R.F.; Miller, D.A.; Nelson, C.J., (1995). Forages. Vol. I: An Introduction to Grassland Agriculture. Iowa State University Pres, Ames, Iowa, USA.

[6] Beck, D.P.; Materon, L.A.; Afandi, F., (1993). Practical Rhizobium-Legume Technology Manual, ICARDA, Aleppo, Syria. 389pp.

[7] Bonaudo, T.; Bendahan, A.B.; Sabatier, R.; Ryschawy, J.; Bellon, S.; Leger, F.; Magda, D.; Tichit, M., (2014). A groecological principles for the redesign of integrated crop–livestock systems Eur. J. Agron. 57: 43–51 (9 Pages).

[8] Bouwman, A.F.; Beusen, A.H.W.; Billen, G., (2009). Human alteration of the global nitrogen and phosphorus soil balances for theperiod 1970–2050. Glob. Biogeochem. Cycles 23 GB0A04. Bowen G. D. and Zapata F. (1991). Efficiency in uptake and use of N by plants. In: Proceeding Series Stable Isotopes in Plant Nutrition Soil Fertility and Environmental Studies. IAEASM 313/130, Vienna, Austria, 349-362 (14 Pages).

[9] Butorac, A.; Basic, F.; Redzepovic, S.; Vasil, J.D., (1988). Investigation into the possibilities of growing lucerne (Medicago sativa L.) on acidic luvisols of thinly covered karst. Znanstvena Smorta, 53: 5-12 (8 Pages).

[10] Cihacek, L.J., (1994). Alfalfa nutrient needs and fertilization. In: WORKSHOP SOBRE O POTENCIAL FORRAGEIRO DA ALFAFA (Medicago sativa L.) NOS TRÓPICOS, Juiz de Fora, Anais, Juiz de Fora: EMBRAPA, CNPGL, p. 93-97 (5 Pages).

[11] Delgado, I.; Andueza, D.; Munoz F.; Martinez, N., (2001). Effect of nitrogen fertilization on alfalfa (Medicago sativa L.) regrowth and production. Options Mediterraneanes Serie A, Seminaries Mediterraneanes, 45: 141-143 (3 Pages).

[12] Hartwig, U.A.; Soussana, J.F., (2001). Ecophisiology of symbiotic N2 fixation in grassland legumes. In: Isselstein J., Spatz G., Hofmann M. (eds.) Organic Grassland Farming.Grassland Science in Europe, 6: 23-26 (4 Pages).

[13] Heichel, G.H.; Henjum, K.I., (1991). Dinitrogen fixation, nitrogen transfer and productivity of forage legume grass communities. Crop Science, 31: 202-208 (7 Pages).

[14] Herrero, M.; Thornton, P.K.; Notenbaert, A.M.; Wood, S.; Msangi, S.; Freeman, H.A.; Bossio, D.; Dixon, J.; Peters, M.;van de Steeg, J.; Lynam, J.; Parthasarathy Rao, P.; Macmillan, S.; Gerard B.; McDermott, J.; Seré, C.; Rosegrant M., (2010). Smart investments in sustainable food production: revisiting mixed crop-livestock systems, Science, 327: 822–825 (4 Pages).

[15] Herridge, D.F.; Peoples, M.B.; Boddey, R.M., (2008). Global inputs of biological nitrogen ûxation in agricultural systems Plant Soil, 311: 1–18 (18 Pages).

[16] Jing-Wei Fan; Yan-Lei Du; Neil, C.; Turner, Bing-Ru Wang; Yan Fang, Yue Xi, Xiao-Ran Guo, Feng-Min Li (2015). Changes in root morphology and physiology to limited phosphorus and moisture in a locally-selected cultivar and an introduced cultivar of Medicago sativa L. growing in alkaline soil. Plant and Soil, DOI: 10.1007/s11104-015-2454-0. 392 (1-2): 215-226 (12 Pages).

[17] Justes, E.; Thiébeau, P.; Avice, J.Ch.; Lemaire, G.; Volenec, J.; Ourry, A., (2001). Influence of summer sowing dates, N fertilization and irrigation on autumn VSP accumulation and dynamics of spring regrowth in alfalfa (Medicago sativa L.). J. Expt. Bot., 53: 111-121 (11 Pages).

[18] Kertikova, D., (2008). The newest achievements in lucerne breeding in Bulgaria. In Proc. Breeding 08, 24-27 Nov. 2008, Novi Sad, Serbia, pp. 509-512 (4 Pages).

[19] Keskin, B.; Yilmaz, I.; Zorer, S.; Arvas, O., (2009). Yield Properties of Some Alfalfa Cultivars in East Anatolia Region of Turkey. Research Journal of Biological Sciences, 4 (6): 720-723 (4 Pages).

[20] Kostov, O.; van Cleemput, (1997). Biological N 2 fixation of copper contaminated soils. Fertilization for sustainable plant production and soil fertility, 11th World Fertilizer Congress of CIEC, 664-671 (8 Pages).

[21] Kot's, S.; Ya.; Nitchik, M.M.; Startchenkov, E.P., (1990). Effect of big doses of lime on effectiveness on phosphorite meal in soddy-podzolic heavy loamy soil. Agrochemistry, Nauka, Moscow, 6: 11-17 (6 Pages).

[22] Kot's, S.; Starchenkov, E.; Nichik, M., (1996). Nitrate reductase activity in alfalfa plants supplied with increasing rates of mineral nitrogen and inoculated with different Rhizobium meliloti strains. Russian J. Plant Physiol., 43 (4): 486-491 (6 Pages).

[23] Kot's, S.Ya., (2001). Physiological bases of highly efficient functioning of alfalfa symbiotic systems in agrocenoses. PhD thesis, Ukraine. (in Russian).

[24] Lassaletta, L.; Billen, G.; Grizzetti, B.; Garnier, J.; Leach, A.M.; Galloway, J.N., (2014a). Food and feed trade as a driver in the global nitrogen cycle: 50-year trends. Biogeochem., 118: 225-241 (17 Pages).

[25] Lassaletta, L.; Grizzetti, B.; Billen, G.; Anglade, J.; Garnier, J., (2014b). 50-year trends in nitrogen use efûciency of world cropping systems: the relationship between yield and nitrogen input to cropland. Environmental Research Letters, 9 (2014) 105011 (9pp), doi:10.1088/1748-9326/9/10/105011.

[26] Milev, G., (2014). Effect of Foliar Fertilization on Nodulation and Grain Yield of Pea (Pisum sativum L.). Turk. J. Agric. Natur. Scis. Special Issue: 1: 668-672 (5 Page).

[27] Mueller, N. D.; Gerber, J. S.; Johnston, M.; Ray, D. K.; Ramankutty N., Foley J. A. (2012). Closing yield gaps through nutrient and water management Nature, 490: 254– 257 (4 Pages).

[28] Naydenova, Y.; Pachev, I., (2009). Forage quality analysis of lucerne grown at different soil cultivation and fertilizing. Journal of Mountain Agriculture on the Balkans, 2009, 12 (2): 291-303 (13 Pages).

[29] Oliveira, W.S.; Oliveira, P.P.A.; Corsi, M.; Duarte, F.R.S.; Tsai, S.M., (2004). Alfalfa yield and quality as function of nitrogen fertilization and symbiosis with Sinorhizobium meliloti. Scientia Agricola (Piracicaba, Brazil), 61:1-7 (7 Pages).

[30] Pachev, I., (2001). Study on optimization of fertilization of lucerne for forage. Proceedings of the Union of Sciences, Russe, 31-34 (4 Pages).

[31] Page, A.L.; Miller, R.H.; Keeney, D.R., (1982). Methods of soil analysis. Part 2. Chemical and Microbiological Properties. Second Edition, American Society of Agronomy. Inc., Soil Science Society of America, Inc., Madisson, Wiskonsin, USA.

[32] Petkova, D., (1994). Effect of the fertilization with nitrogen and some microelements on the productivity during the first year of alfalfa grown for seeds. Plant Science, 31 (5- 6): 33-37 (4 Pages). (In Bulgarian).

[33] Power, J. F.; Alessi, J., (1971). Nitrogen fertilization of semiarid grassland: plant growth and soil mineral N levels. Agron. J., 64: 277–280 (4 Pages).

[34] Raun, W.R.; Johnson, G.V.; Phillips, S.B.; Thomason, W.E.; Dennis, J.L.; Cossey, D.A., (1999). Alfalfa yield response to nitrogen applied after each cutting. Soil Science Society of America Journal, 63: 1237-1243 (7 Pages).

[35] Richardson, A.E.; Berea, J.M., (2009). Acquisition of phosphorus and nitrogen in the rhizophere and plant growth promotion by microorganisms. Plant Soil 321: 305-339 (35 Pages).

[36] Serraj, R.; Sinclair, T.; Purcell, L., (1999). Symbiotic N 2 fixation response to drought. Journal of Experimental Botany, 50 (331): 143-155 (13 Pages).

[37] Sharma, P.K.; Sharma, B.L., (1995). Effect of nitrogen and schedule of its application on forage yield of lucerne (Medicago sativa L.). Indian Journal of Agronomy, 40 (4): 718-720 (3 Pages).

[38] Sinclair, T.R.; Rufty, T.W., (2012). Nitrogen and water resources commonly limit crop yield increases, not necessarily plant genetics Glob. Food Sec., 1: 94–98 (5 Pages).

[39] Soussana, J-F.; Lemaire, G., (2014). Coupling carbon and nitrogen cycles for environmentally sustainable intensiûcation of grasslands and crop-livestock systems Agric. Ecosyst. Environ. 190: 9–17 (9 Pages).

[40] SPSS 2012. SPSS Version 20.0. SPSS Inc., 233 S. Wacker Drive, Chicago, Illinois.

[41] Starchenkov, E.; Kot's, S., (1992). Biological nitrogen in agriculture and role the lucerne to replenish its reserves in the soil. Physiology and Biochemistry of Crop Plants, 24 (4): 325-338 (14 Pages).

[42] Streeter, J., (1985a). Nitrate inhibition of legume nodule growth and activity. I. Long-term studies with a continuous supply of nitrate. Plant Physiol., 77: 321-324 (4 Pages).

[43] Streeter, J., (1985b). Nitrate inhibition of legume nodule growth and activity. II. Short-term studies with high nitrate supply. Plant Physiol., 77: 325-328 (4 Pages).

[44] Streeter, J.G., (1993). Translocation - A key factor limiting the efficiency of nitrogen fixation in legume nodules. Physiol. Plant., 87 (4): 616-623 (8 Pages).

[45] Tairo, E.V.; Ndakidemi, P.A., (2013). Yield and economic benefits of soybean as affected by Bradyrhizobium japanicum inoculation and phosphorus supplementation. American J. Res. Communication.1(11): 159-172 (14 Pages).

[46] Tilman, D.; Cassman, K.G.; Matson, P.A.; Naylor, R.; Polasky, S., (2002) Agricultural sustainability and intensive production practices. Nature, 418: 671–677 (7 Pages).

[47] Trepachev, E. P., (1999). Agrochemical aspects of biological nitrogen in modern agriculture, Ì., 532 p.

[48] Tufenkci, S.; Erman, M.; Sonmez, F., (2006). Effect of nitrogen application and Rhizobium inoculation on the yield and nutrient uptake in lucerne (Medicago sativa). Bulletin of Pure and Applied Sciences-Botany, 25, 1.

[49] Van der Velde, M.; Folberth, C.; Balkoviè, J.; Ciais, P.; Fritz, S.; Janssens, I.A.; Obersteiner, M.; See L., Skalský R., Xiong W., Peñuelas J., (2014). African crop yield reductions due to increasingly unbalanced Nitrogen and Phosphorus consumption. Global Change Biology, 20: 1278–1288 (11 Pages).

[50] Vasileva, V., (2004). Effect of nitrogen fertilization on growth, nodulation and productivity of lucerne (Medicago sativa L.) at optimal and water deficit conditions. PhD thesis, Pleven, Bulgaria.

[51] Vasileva, V.; Ilieva, A., (2011). Chemical composition, nitrate reductase activity and plastid pigments content in lucerne under the influence of ammonium and nitrate form mineral nitrogen. Agronomy Research, 9 (1-2): 357-364 (8 Pages).

[52] Vasileva, V.; Kostov, O.; Vasilev, E., (2006). Development of lucerne (Medicago sativa L.) treated with mineral fertilizer and manure at optimal and water deficit conditions. Comm. Appl Biol. Sci. Ghent University, 71 (4): 5-17 (13 Pages).

[53] Vasileva, V.; Kostov, O.; Vasilev, E.; Athar, M., (2011). Effect of mineral nitrogen fertilization on growth characteristics of lucerne under induced water deficiency stress. Pakistan Journal of Botany, 43 (6): 2925-2928 (4 Pages).

[54] Vasileva, V.; Pachev, I., (2009). Effect of different doses of fertilizing and soil cultivation on nodulation of lucerne (Medicago sativa L.) grown for forage. Agrochemistry and Soil Science, 2009, Proceedings, issue 71, Harkov, Agricultural Academy Ukraine, National Research Centre of the Instiiute of Soil Science and Agrochemistry, 70-74 (5 Pages).

[55] Vasileva, V.; Pachev, I., (2015). Root mass accumulation after different fertilization and soil cultivation of alfalfa (Medicago sativa L.). Agronomy, Special Issue "Towards a Better Understanding of Agronomic Efficiency of Nitrogen in Different Agro-Ecosystems", in press.

[56] Werner, D.; Newton, W.E., (2005). Soil stress factors influencing symbiotic nitrogen fixation. In: Nitrogen Fixation in Agriculture, Forestry, Ecology, and the Environment. Series: Nitrogen Fixation: Origins, Applications, and Research Progress, Springer, pp. 89-102 (14 Pages).

[57] Yousefi, M.; Mohammadi, A., (2011) Economical analysis and Energy use efficiency in Alfalfa production systems in Iran. Sci. Res. Essays 6 (11): 2332-2336 (5 Pages).