Macronutrients in grass plants and its effect on seed yield

Grzegorz Żurek[1*], Kamil Prokopiuk[1], Danuta Martyniak[1], Eugeniusz Paszkowski[2], Urszula Woźna – Pawlak[3], Maciej Jurkowski[4]

[1] Instytut Hodowli i Aklimatyzacji Roślin, Państwowy Instytut Badawczy, Radzików, 05-870 Błonie; [2] DANKO Hodowla Roślin sp. z o.o., 64 – 000 Kościan; [3] Poznańska Hodowla Roślin, sp. z o.o., 63 – 004 Tulce; [4] Małopolska Hodowla Roślin, sp. z o.o., 30 – 002 Kraków

*** - corresponding author, e-mail: g.zurek@ihar.edu.pl**

INTRODUCTION: Recent environmental concerns has brought restrictions to the amount of macronutrients (nitrogen, potassium, sodium etc.) that farmers are allowed to use in seed production areas. Excess amounts of nutrients applied to seed crops may also result in seed retention, reduced seed set etc. negative effects. Defining economically optimum macronutrients application rates has become increasingly important. However, before discussing fertilization regimes, it is important to know if there are any relations between mineral composition of plants and its performance, i.e. morphology, phenology or seed yield. Therefore, the aim of our work was to relate contents in macronutrients (N, P, K, Ca and Mg) in mature plants with its seed yield components.

MATERIALS & METHODS:
Relations between macronutrients contents in plants and seed yield were examined during two-years field studies located in Radzików, Poland. Fifteen grass genotypes from three fescue species: tall fescue (*Festuca arundinacea* Schreb.), meadow fescue (*F. pratensis* Huds.) and red fescue (*F. rubra* L.) were used, including commercial varieties, breeding lines and ecotypes. Despite of observations and measurements made (see below) some (ca. 5 – 10) plants per genotype were harvested and prepared for chemical analysis. Contents of macronutrients (i.e. N total, P, K, Mg and Ca) were determined in plants grown in Radzików at the full development phase (after seed set but before seed maturity).

Traits measured and observed:
overwintering [**OW**], in scale 1 – 9, where 1 – plants completely destroyed, 9 – plants vigorous; plant growth habit [**GH**], in scale 1 – 9, where 1 – plants completely flat, 9 – plants erect; mean heading start date [**HE**], number of days from the 1-st of April to that moment when on 30% of spaced plants on plot 'emerged' tillers were visible; mean flowering start date [**FE**], number of days from the 1-st of April to that moment when on 30% of spaced plants on plot at least single anthers were visible; estimated biomass yield [**BY**], in scale 1 – 9, where 1 – the lowest yield, 9 – the highest yield; plant height [**PH**] (cm), steam leaf length [**LL**] (cm); steam leaf width [**LW**] (cm), number of generative stems per plant [**NGS**]; inflorescence length [**FL**] (cm); single panicle seed yield [**SI**] (g); seed yield of single plant [**SY**] (g); seed yield of plot [**SP**] (kg); thousand seed weight [**TSW**] (g); chlorophyll contents index [**CCI**], measured with CCM200 Plus.

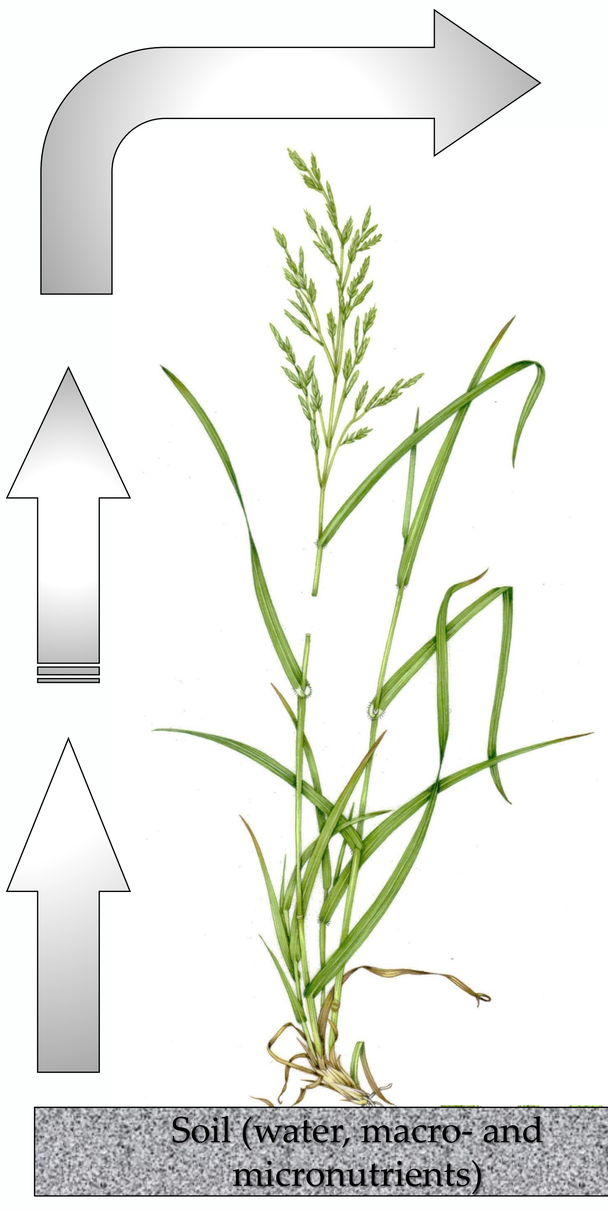
RESULTS:
There were **negative** relations between macronutrient contents and SY, as well as positive in case of SI. Both, Pearson correlation coefficients and multiple regression analysis gave negative signs of relations between SY and P for *Festuca arundinacea*. Correlation coefficients were also significant and negative for N and K (*F.pratensis*) and K – for *F.rubra*. Multiple regression analysis gave also high, but negative predictors value for Mg contents vs. SY in *F.rubra*. Seed yield from the single panicle (SI) which in fact determines SY, was positively related to N and K contents for *F.pratensis* and *F.rubra*.

Pearson correlation coefficients

Genus, species	Macro-nutrient	Traits related to vegetative phase of plant development								Traits related to generative development and seed yield					
		OW	GH	BY	PH	LL	LW	LA	CCI	HE	FE	NGS	FL	SI	SY
F.arundinacea	N		-0,64								0,71				
	P														-0,66
	K		0,70		0,64										
	Mg														
	Ca														
F.pratensis	N			0,73		0,89		0,71	0,73	0,92	0,80	-0,71	0,64	0,89	-0,70
	P									0,71	0,64				
	K		-0,87		-0,79	0,71		0,79	0,65	0,75		-0,79		0,79	-0,79
	Mg														
	Ca						0,77								
F.rubra	N		-0,87	0,74						0,88	0,86			0,79	
	P									0,68	0,76				
	K		-0,66							0,82	0,81		0,70	0,64	-0,71
	Mg										0,72			0,64	
	Ca														

Multiple regression analysis

Model / Trait	SI - seed yield per single panicle									SY - seed yield per plant								
	Festuca									*Festuca*								
	arundiacea			*pratensis*			*rubra*			*arundinacea*			*pratensis*			*rubra*		
	b*	b	p	b*	b	p	b*	b	p	b*	b	p	b*	b	p	b*	b	p
Constant		-7,15	n.s.		1,18	n.s.		-4,78	n.s.		87,08	n.s.		-29,12	n.s.		123,58	n.s.
OW	0,22	0,28	0,02															
GH				-0,34	-0,14	0,05												
HE	-0,56	-0,07	0,01	-0,80	-0,06	0,05												
FE	0,49	0,05	0,00	0,74	0,06	0,04												
BY				0,40	0,17	0,01												
PH													0,34	0,12	0,05			
LL				0,38	0,05	0,02										-0,9	-0,6	0,0
LW																0,7	103,3	0,0
NGS																		
FL	0,40	0,04	0,01							1,15	0,47	0,00						
CCI				0,36	0,08	0,01												
N																2,0	17,3	0,0
P										-1,33	-102,82	0,00						
K																		
Mg																-1,0	-211,6	0,0
Ca	-0,26	-4,83	0,03															
R^2 corrected	0,95			0,90			0,73			0,72			0,78			3,24		
Std. error of est.	0,250			0,140			0,182			2,67			0,99			0,64		



CONCLUSIONS:
1. Amounts of N, P and K found in high seed-yielding genotypes were relatively low as compared to low seed producing genotypes.
2. This is most probably because high seed yields requires relatively high inputs from plant.
3. High seed yield will not only depend on the amount of fertilizer applied but on grass genotype also.

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