The Role of Glucosinolates of Brassica Genus in the Growing System

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ABSTRACT.

Glucosinolates of *Brassica* genus as secondary metabolites have a lot of functions as sulphur supply and their anti-nutrition, anti-microbial, anti-fungicidal, and anti-bacterial effects and as being natural bio-fumigants. Glucosinolates form less than 2% of the overall sulphur at the beginning of vegetation in different parts of the plants and during growth their content is decreasing and forms less than 0,1%. This low representation doubts their storage function. Due to their chemical composition they are ranked among the natural pesticides with active and passive resistance against diseases and pests. They show repellent effects and properties of natural biofumigators in soil after ploughing in their biomass at green fertilization, or after ploughing in after harvest leftovers of rape. The principle of these effects are decomposition products of glucosinolates - bioactive isothiocyanates. Very important, from this point of view, are turnip rape Rex and *Brassica juncea. The* content of these compounds is the highest one and they are resistant against the attack of *C. pleurostigma.* The same effect appeared also when attacked by *Phoma lingam*. In other winter Brassicas either hybrid or line varieties and summer rape this defensive system is suppressed because of their lowered content due to breeding interferences, leading to the limitation of their anti-nutritional negative effects but on the other side they brought about important interventions in sulphur metabolizing.

Key words: glucosinolates – biocides – biofumigants – *Ceutorrhynchus pleurostigma* – *Phoma lingam*

INTRODUCTION

In the Brassica genus**,** 8 the most significant substances have been identified. No primary physiological role is attributed to glucosinolates. As secondary metabolites, they have or they are given many function: 1. storage of sulfur, mainly in seeds, 2. Natural protection of the plant. Next to the prepared passive defensive systém (Giamoustaris and Mithen 1995) It also an active one (Takasugi et al.1986) 3. Biofumigation effect of *Brassicacae* of following crops

MATERIAL AND METHODS

The experiment was carried out at the experimental ground of the research Station of the faculty of Agronomy of the CUA. Determination of different glucosinolates was determined by gas chromatography after conversion to desulfoglucosinolates. Total sulphur was determined on the apparatus ICP-AES Trace SCAN. Sulphates were determined on the analysator SAN Plus, Systém- Skalar after the extraction of dry matter of the plants into water.

RESULTS and DISCUSSION

Glucosinolates as sulphur suppliers.

Sulphates are the main uptake form of sulphur for the plants. Sulphur is a building element of the essential amino acids (methionine, cysteine) which are essential parts of quality proteins. The synthesis of amino acids can be considered as primary metabolites. Glucosinolates, as the secondary metabolites, are the minority components of the sulphur compounds and the seed is the primary distribution place of glucosinolates. Their minimum content was found in the vegetative parts of the the rape plant. Glucosinolates create less than 2% of the total sulphur content in the start of vegetation in individual plant parts and their content decreases in the course of growth and create less than 0,1% (Tab.2).

Table 1. Physiological effects of glucosinolates

Group	Content (% relation)	Anti-nutritive effects	phyto-anticipines phyto-alexines	*decomposition product*
I.aliphatic GSL[1]	25,16	weak	phyto – anticipines – passive protection againts pests.	***iso-thio-cyanates***
II.hydroxy GSL[1]	66,63	strong,	-	anti-nutritive effects – ***VTO***[2]
III. indolyl GSL	8,2	-	phyto – alexines active protection of plants	***thio-cyanates***

1.-GSL – glucosinolates, 2.-VTO - vinylthiooxazilidinethione

The low content of glucosinolates in the rape plant vegetation parts questions their suppling function (Fieldsend, Milford, 1994). Sulphates represent the substantial component of the content of total sulphur in the vegetative parts of rape plants (Tab.2). It is still a question, if it is the only exhibition of the low effectiveness of their exploitability for the synthesis of the primary and secondary metabolites or the mineral form of sulphur - the sulphates in rape plant fulfil some further mission.

Table 2. Content of total sulphur. sulphates and glucosinolates in different parts of the plant during growth.

		Total sulphur	**Sulphate**	**Glucosinolates**
	phase	(μmol/g dry matter)	(% of total sulphur)	(μμmol/g dry matter)
rosette	leaf	291,56	39	1,38
	roots			0,96
budding	leaf	199,38	73	1,22
	stem	108,44	56	1,41
	roots	118,44	23	0,41
full flower	leaf	135,63	68	0,88
	stem	42,19	48	0,24
	inflorescence	111,25	32	0,61
	roots	55,00	34	0,25
ripening	stem	35,94	60	0,04
	inflorescence	69,69	83	1,32
	pods	61,25	47	1,20
	roots	43,13	36	0,06
harvest	stem	17,19	62	0,01
	inflorescence	35,63	37	0,00
	pods	44,69	77	0,45
	seeds	107,81		4,86

For further considerations concerning the physiological effects of glucosinolates according to the character of the decomposition products (Tab.1), their division into three groups is useful.

The first group (Tab.1) of glucosinolates of aliphatic character, in which *iso-thio-cyanates* are created by their hydrolysis in the neutral and alkaline environment.

These bioactive compounds have the following effects:

1. *The anti-nutritive effects.*- They bind iodine selectively and they prevent thyroidal gland from the iodine intake.
2. *The anti - microbial, anti – fungicidal, anti - bacterial and thyroidal properties*, which create the natural protection of plant itself (Wallsgrove at al., 1999).
3. *The function of glucosinolates as bio- fumigants.*

It is based on the same hydrolytic principle as the natural protection of the plant with the difference that the ploughed in biomass of green manure leaves the bioactive iso-thio- cyanates in soil, where, apart from the aliphatic iso-thio-cyanates (Sarvar et al., 1988) are also aromatic forms that exhibit higher toxicity.

The second group (Tab.1) are hydroxy – glucosinolates which occupy the highest percentage, most significant from the point of anti – nutritive effect. The decomposition products of hydroxy- glucosinolates – iso-thio-cyanates are not stable and they cycle while creating the substituted 2-oxazolidinethione (goitrine – VTO). These glucosinolates represent a serious problem in the feed industry. The decomposition product – goitrine – is the strongly goitrogenic. Contrary to this, in turnip rape and *Brassica juncea,* the protective and bio - fumigatory effects should prevail due to the prevailing composition of the glucosinolates of the Ist class.

Table 3. The contents of individual glucosinolates of Brassica genus (µmol/g extr. meal)

Variety	Glucosinolates (GSL)/group[6]				
	Sinigrin/I .(µmol/g extr. meal)	Gluconapine/I. (µmol/g extr. meal)	Glucobrassicanapine/I(µmol/g extr. meal)	Progoitrine/II. (µmol/g extr. meal)	∑GSL (µmol/g extr. meal)
Lirajet[3]	-	4,13	0,47	12,18	16,78
Pronto[4]	-	4,38	0,47	9,60	14,45
Lirajet GMO[1]	-	1,95	0,14	5,85	7,94
Ms8 -Rf_3[2]	-	2,08	0,25	6,08	8,41
Jet neuf [5]	-	32,48	2,70	90,43	130,61
Brassica juncea	122,41	14,11	0,94	3,98	141,44
Rex – turnip rape	-	36,97	11,76	6,32	55,05

1- Transgenic rape plant "00" - Roundup Ready, 2- Transgenic hybrid rape plant "00"- Basta (Liberty Link), 3-Lineal rape plant"00", 4-Hybrid rape plant "00", 5-lineal rape plant "0", 6-group – viz Tab.1

The protection effect against *Ceutorrhynchus pleurostigma* is very important from this point of view, its main occurence is during IX/X month (Tab.4), when the contents of glucosinolates are the highest. During both experimental years the attack by this pest was the lowest in turnip rape Rex and Brassica juncea with a high content of glucosinolates, of group I (Tab.3). The attack by phoma (*Phoma lingam),* was similar and the lowest in the variety Rex and Brassica juncea.

The third group (Tab.1)- Glucosinolates containing the indole group or the benzene ring (Sinalbin). Thio–cyanates are formed by their hydrolysis. It is not completely clear if they are the cause of the nutritional.(anti – carcinogenic) or toxic problems. These glucosinolates in the Brassica plants participate in the active protectionand they fulfil the role of phyto- alexines (Takasugi *et al., 1986).*

Table 4.Different Brassicas of attacked plants (%).

Brassicas	***C. pleurostigma***		***Phoma lingam***	
year	2001	2000	2001	2000
Turnip rape - Rex	20%	0%	66%	48%
Hybride rape - Pronto	98%		96%	
Summer rape	100%	27%	100%	87%
Winter rape - Prestol	99%	30%	78%	17%
Brassica juncea	13%	0%	74%	20%

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