

SHORT COMMUNICATION

Effect of Luteolin (Flavone) and Temperature Regimes on Nodulation in Dark Red Kidney Bean (Phaseolus vulgaris L.)

Osman A. Sidahmed¹, D.A. Phillips² and A.E.S. Ibrahim¹

1. Faculty of Agricultural Sciences, University of Gezira, Medani, Sudan.
2. Department of Agronomy and Range Science, University of California, Davis, CA, 95616.

ABSTRACT:

10 μ M luteolin significantly increased number and mass of nodules over control (0 μ M) under the four temperature regimes. The plant dry weight was significantly increased by 10 μ M luteolin under the extremes of the temperature range (20/15 $^{\circ}$ C and 35/30 $^{\circ}$ C), while no significant differences were observed at the moderate temperature range (25/20 $^{\circ}$ C and 30/25 $^{\circ}$ C).

The data for percent and total nitrogen was affected significantly by luteolin application. These findings clearly indicate that luteolin plays an important role in promoting root nodule initiation and thereby nitrogen economy in the "Dark Red Kidney" bean.

Keywords : Dark red kidney bean (Phaseolus vulgaris L), Luteolin, nodulation, temperature regimes.

Data from different research groups show that a plant flavone (luteolin) and nod. D gene product induce transcription of nod ABC in rhizobia that nodulated alfalfa (Peters et al., 1986), clover (Redmond et al., 1986) and peas (Firmin et al., 1986). In peas, specific flavones also promote transcription of nod. genes, while two isoflavones are inhibitory (Firman et al., 1986). Those findings indicate that host legume plays an important role in promoting or possibly inhibiting root nodule initiation. This experiment was initiated to test whether flavone synthesis and/or secretion in this agronomic crop can serve as a quantitative control over root nodule initiation and N₂-fixation.

Plants were grown in Leonard jars with *R. leguminosarum* biovar phaseoli NA 575 under 16/8 h light/dark cycle, day/night temperatures of 20/15°C, 25/20°C, 30/25°C or 35/30°C and a photosynthetic photon flux density (400–700 nm) of 650 UE02 S01. The N-free solution (Phillips et al., 1985) was supplemented to contain 10 uM luteolin (3', 4', 5, 7-tetrahydroxy flavone) in the nutrient solution and added to the jars before planting. No luteolin was added when the nutrient solution was replenished during the course of the experiment. A completely randomized design with four replications was used. Ten plants per replication were harvested 21 days after germination and nodule number, mass and dry matter accumulation determined. Total nitrogen was estimated by the macro-kjeldahl method.

The data for the different plant characteristics measured is presented in Table 1. 10 uM luteolin significantly increased number and mass of nodules over control (0uM) under the four temperature regimes. These findings clearly indicate that luteolin plays an important role in promoting root nodule initiation in Dark Red Kidney beans.

Table 1. Effects of luteolin and temperature on nodulation, growth and total nitrogen of "Dark Red Kidney" bean.

Temp C. 16hr day/ 8hr night	Luteolin UM	No. Nod/ plt	Nod Mass mg/plt	Ave Nod Mass mg/nod	Dry Wt.				Total N mg/plt	
					Shoot -----g/plt-----	Root	Shoot N %	Root N %		
20/15	0	19	1.0	.050	.168	.070	.239	5.42	3.58	11.7
	10	103*	7.8*	.076	.272**	.125*	.405**	4.55	3.35	16.6*
25/20	0	193	45	.22	.272	.128	.445	3.20	2.65	13.4
	10	403***	92*	.23	.338	.178	.607	3.69*	2.58	19.4
30/25	0	132	77	.61	.612	.325	1.01	2.50	1.60	21.2
	10	325*	148*	.47	.628	.212	.99	3.58**	21.2	33.8**
35/30	0	0.3	.2	.19	.445	.225	.67	1.78	1.46	11.2
	10	32**	26*	.81*	.532	.352**	.91*	1.86	1.49	15.5*
LSD 0.05		76	.34	.27	.104	.078	.185	0.95	0.45	4.6

*, **, *** Luteolin effect significant at P < 0.05, 0.01, or 0.001, respectively.

Total dry weight of the plant was significantly increased by 10 μ M luteolin under the extremes of the temperature range (20/15°C and 35/30°C), while no significant differences were observed at the moderate temperature range (25/20°C and 30/25°C). Root dry weight was similarly affected, however, effect of luteolin on shoot dry weight was only significant at the low temperature regime (20/15°C).

At the temperature regime 30/25°C luteolin treated plants had significant high nitrogen concentration in shoots and roots. Total nitrogen was also higher in luteolin treated plants raised at 30/25°C. Significant differences in total nitrogen were also observed in luteolin treated plants raised at 20/15°C and 35/30°C. At 25/20°C only shoot %N was significantly higher in luteolin treated plants, while total nitrogen was high but not significantly so.

Further work on determination of flavonoid profiles and bioassay for flavonoid nodulation signals is in progress. The bioassay for flavonoid nodulation signals will be done by testing for induction of B-galactosidase activity from a nod. C-lac.z fusion, *R. leguminosarum* biovar kindly provided by A.W.B. Johnston of the United Kingdom.

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تأثير الليوتولين (فلافون) ونظم الحرارة على تكوين العقد الجذرية لنباتات الفاصوليا الكلوية الحمراء (*Phaseolus vulgaris* L.)

عثمان علي سيداحمد^١ و د.أ. فيليب^٢ وأبو الحسن صالح إبراهيم^١

١. كلية العلوم الزراعية ، جامعة الجزيرة ، مدني ، السودان .
٢. شعبة المحاصيل وعلوم المراعي ، جامعة كلنورنيا ، ديفس ، كلنورنيا ٩٥٦١٦ ، الولايات المتحدة الأمريكية .

الخلاصة

أدى استعمال 10µM ليوتولين إلى زيادة معنوية في عدد وحجم العقد الجذرية مقارنة بالشاهد وتحت نظم الحرارة الأربعة المتضمنة في التجربة . ازداد وزن النبات الجاف زيادة معنوية باستعمال 10 µm ليوتولين تحت ظروف أطراف المدى الحراري المستعمل (٢٠/١٥ °م و ٢٥ / ٣٠ °م) وكان الفرق غير معنوي في هاتين الصفتين تحت ظروف المدى الحراري المتوسط (٢٥ / ٢٠ °م و ٣٠ / ٢٥ °م) . أثبتت النتائج أن استعمال الليوتولين أدى إلى زيادة معنوية في نسبة العقد الجذرية والانتاج الكلي للتبروجين وعليه أوضحت نتائج التجربة أن الليوتولين يلعب دوراً هاماً في تنمية وفعالية العقد الجذرية لمحصول الفاصوليا وكذا اقتصاديات استعمال الأسمدة التيتروجينية لهذا المحصول الهام .

كلمات مفتاحية : تكوين العقد الجذرية ، الفاصوليات الكلوية الحمراء (*Phaseolus vulgaris* L.) ، ليوتولين ، نظم الحرارة .