

## GRAPE YIELD AND QUALITY OF THE GRAPEVINE CULTIVAR LIMBERGER TREATED WITH PLANT GROWTH REGULATORS

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**Abstract:** The effects of foliar application of paclobutrasol (PK), chlorcholinechloride (CC) and gibberellic acid (GA<sub>3</sub>) on grape yield and quality of the grapevine cultivar Limberger were studied. PK and CC strongly inhibited shoot growth. The number of berries per bunch, bunch weight and grape yield per m<sup>2</sup> were increased. At the same time, sugar content of must was either reduced (CC2000) or retained at the level of control (PK1000, CC1000). The GA150 treatment resulted in lower grape yield. At the concentration of GA<sub>3</sub> - 100mg/l no significant increase in yield was found, whilst sugar content of must was significantly increased.

**Key words:** growth inhibitors, gibberellic acid, berry set, grape yield, sugars, acid.

### **I n t r o d u c t i o n**

The application of growth regulators in viticulture is a constituent part of biotechnology. It is often necessary to act against luxuriant vine growth, which affects grape yield. The application of a great number of growth regulating substances, such as ethephone, paclobutrasol, chlorcholinechloride evidenced great importance of those substances in achieving a balance between plant growth and quality cropping. This is especially important for cultivars that in their nature tend to develop luxuriant and very luxuriant vines (Cindrić, 1974).

In our trials on the grapevine, it was assumed that the application of growth inhibitors at the stage of intense shoot growth might retard it, which results in developing more favorable conditions for fertilization and set of a larger number of berries. Also, there is less possibility for inflorescences to be modified into

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tendrils and for flowers and young berries set to decrease in their number (Formento et al., 1982; Bindra et al., 1983; Lilov and Angelova, 1987). Higher grape yield therefore can be expected.

### Material and Methods

Trials were carried out in one of the vineyards situated within a large “Rasadnik” holding of “Jagodinski Podrumi” Ltd. Liability Co., a branch of “Navip” Co. The row spacing is 3 m and between the vines in a row 1.2 m. The training system is modified two-sided Casenev cordon. It consists of two trunks developed from the vine basis. At a 90-cm height two shorter horizontal cordons were trained with two fertile knots each, where mixed pruning is performed. Trials were carried out on the Merlot cultivar grafted on V. Berlandieri x V. Riparia – SO4 sel. Openheim rootstock.

Plant growth regulating substances of opposite effects were employed in the trials-growth inhibitors such as paclobutrasol and chlorcholinechloride and extremely effective growth promotant such as gibberellic acid. Paclobutrasol is triazol derivative. In its chemical composition it is (2RS, 3RS)-1-(4-chlorophenyl)-4,4-dimethyl-2-(1,2,4-triazol-1-yl) pentane-3-ol. Chemical composition of chlorcholinechloride is 2-chloroethyl-3-methylammoniumchloride (Cl-CH<sub>2</sub>-CH<sub>2</sub>-N(CH<sub>3</sub>)-Cl). The active group is trimethylammonium. Gibberellic acid (GA<sub>3</sub>) is organic acid of extremely high physiological activity, whose formula is C<sub>19</sub>H<sub>22</sub>O<sub>6</sub>. Plants were treated foliarly i.e. through leaves, twice during vegetative growth: 10-15 days prior to flowering and 10 – 15 days after full bloom.

The trial variants applied were as follows:

K.....	water treatment (untreated plants)
PK500.....	paclobutrasol treatment at concentration of 500 mg/l
PK1000.....	paclobutrasol treatment at concentration of 1000 mg/l
CC1000.....	chlorcholinechloride treatment at concentration of 1000 mg/l
CC2000.....	chlorcholinechloride treatment at concentration of 2000 mg/l
GA100.....	GA <sub>3</sub> treatment at concentration of 100 mg/l
GA150.....	GA <sub>3</sub> treatment at concentration of 150 mg/l

### Results and Discussion

To eliminate effects of different degrees of load bud on growth, yield and grape quality, we made efforts during regular pruning each year to load

experimental vines with equal number of winter buds. Average number of developed shoots was uniform and ranged from 34.63 – 35.03 and that of fertile shoots was in the 26.10 – 27.63 range (Tab. 1).

T a b.1. - Average number of buds, developed and fertile shoots per vine

Variant	PK1000	PK500	CC2000	CC1000	GA150	GA100	K
No. buds/vine	42.17	42.10	41.97	42.00	42.20	42.27	42.27
Lsd <sub>0.05-0.01</sub>	0.6109 - 0.8478						
buds/m <sup>2</sup>	11.71	11.69	11.66	11.67	11.72	11.74	11.74
No.of developed shoots	35.03	34.70	34.97	34.87	34.87	34.67	34.63
% developed shoots	83.07	82.42	83.32	83.02	82.63	82.02	81.92
Lsd <sub>0.05-0.01</sub>	1.0148 - 1.4085						
No.fertile shoots	27.67	26.37	27.47	26.80	26.20	27.30	26.10
Lsd <sub>0.05-0.01</sub>	1.7528 - 2.4327						
% offertile hoots	78.99	75.99	78.55	76.86	75.14	78.74	75.37

*Shoot growth.* The studied substances demonstrated the strongest effects on shoot growth in June when monthly shoot growth amounted to 50.93 cm – CC2000; 60.23cm - CC1000; 58.20 cm – PK1000, 73.87 cm – PK500, 98.00 cm – GA150, 82.90 cm – GA100 and 72.67 cm - K; (Fig.1).

In the month of June in variants with growth inhibitors, monthly growth was lower by 19% - PK1000, 29% - CC2000 and 17% - CC1000 compared with control. In variants with gibberellic acid treatment monthly shoot growth was increased, compared with a control, by 14% (GA100) and 35% (GA150), respectively.

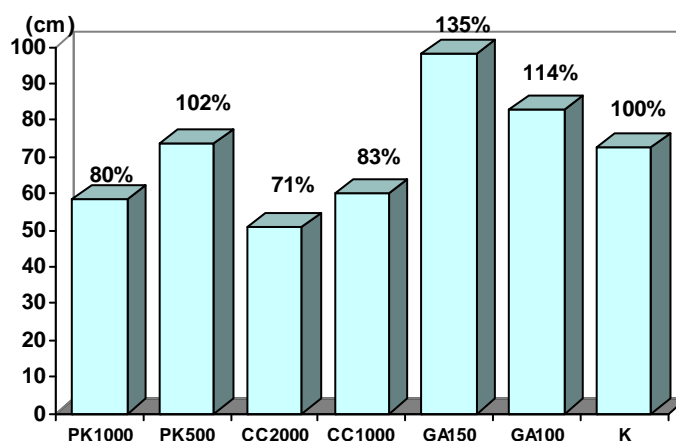


Fig.1. – Monthly shoot growth in June (cm)

Percent of berries set varied from 27.00 (GA150) to 45.60 (CC2000). The application of growth inhibitors produced higher per cent of berries set in the Limberger cultivar, compared with a control, by 9.20% (CC2000); 7.40% (PK1000); 5.90% (CC1000).

T a b. 2. - Percent of berries set in cv. Limberger

Variant	PK1000	PK500	CC2000	CC1000	GA150	GA100	K
No of flowers/ inflorescences	310.00	265.10	321.60	315.00	280.60	288.30	276.40
No of berries set/bunch	135.80	95.60	146.60	133.20	75.80	95.40	100.60
% of setting	43.80	36.08	45.60	42.30	27.00	33.10	36.40

Compared to gibberellic acid treatment (GA150), the application of growth inhibitors led to increased degree of fertilization by 18.6% (CC2000); 16.80% (PK1000); 15.30% (CC1000) and 9.08% (PK500).

Gibberellic acid treatments decreased percent of berries set, compared with a control, by 9.40 (GA150) and 3.30 (GA100) – Tab.2.

The number of bunches per vine ranged from 36.13 (GA150) to 38.43 (GA100). The number of bunches per vine in GA150 treatment was significant by decreased compared with a control. In PK1000, CC1000 and CC2000 treatments, significant increase in bunch weight was achieved, resulting from the increased number of berries per bunch, whilst in GA150 treatment a very significant decrease in the number of berries per bunch and significant decrease in average bunch weight were achieved. In all treatments with growth inhibitors average berry weight was reduced, which was evaluated as significant in the CC2000 variant. Gibberellic acid had quite a contrary effect on berry weight. The achieved increase in berry weight was statistically confirmed (Tab. 3).

T a b. 3. – Average number of bunches per vine, bunch weight and berry weight (g)

Variant	PK1000	PK500	CC2000	CC1000	GA150	GA100	K
Bunches/vine	37.43	37.27	36.90	38.73	36.13*	38.43	38.03
LSD <sub>0.05-0.01</sub>			18910–2.6245				
Bunch weight	151.43*	144.07	153.17*	150.83*	135.50*	149.73	143.07
LSD <sub>0.05-0.01</sub>			7.3121 – 10.1483				
Berry weight	1.64	1.70	1.58*	1.61	1.84*	1.82*	1.70
LSD <sub>0.05-0.01</sub>			0.1080 – 0.1498				
No of berries per bunch	108.10**	105.53	114.47**	108.63**	82.50**	97.10	99.70
LSD <sub>0.05-0.01</sub>			4.0487 – 5.6192				

### Grape yield and quality

The achieved increase in grape yield was significant in the CC1000 variant compared with a control. The GA<sub>3</sub> concentration - 150 mg/l produced a very significant decrease in grape yield per vine.

Sugar content of must varied from 18.40% (C2000) to 20.93% (GA100). The difference achieved between those two variants is significant. In paclobutrasol variant (PK1000) there was a slight tendency towards increase in sugar content of must. The application of chlorcholinechloride caused changes in the chemical composition of must, the effects of application being dependent on concentration. At lower concentration (CC1000) no significant changes were found in sugar content of must, compared with a control. The concentration of 2000 mg/l produced significant decrease in sugar content of must, compared with a control (Tab. 4). In the GA100 variant sugar content of must was increased, compared with both a control and all plants treated with growth inhibitors. Sugar content was significantly increased, compared with a control and CC1000, and very significantly, compared with the CC2000 variant.

Tab. 4. - Average grape yield per vine and square meter (kg) and must quality

Variant	PK1000	PK500	CC2000	CC1000	GA150	GA100	K
Average grape yield per vine and square meter							
Grape yield per vine	5.670	5.370	5.650	5.840*	4.890**	5.760	5.440
LSD <sub>0.05-0.01</sub>	0.3234 - 0.4489						
Grape yield per m <sup>2</sup>	1.5750	1.4917	1.5694	1.622	1.358	1.600	1.5111
Must quality							
Sugar content ° Brix	19.90	19.17	18.40*	19.57	18.77	20.93*	19.57
LSD <sub>0.05-0.01</sub>	1.0010 - 1.3893						
Total acids content g/l	7.63	7.83	7.87	7.27	7.23	7.17	7.30
LSD <sub>0.05-0.01</sub>	3.1969 - 4.4369						

Average content of total acids in must varied from 7.17 (GA100) to 7.87 (CC2000). In all other variants there were not significant deviations in content of total acids in must, compared with a control (Tab. 4).

### Conclusion

The results obtained lead to the conclusions as follows:

The application of paclobutrasol at concentration of 1000 mg/l inhibited shoot growth. The highest inhibition of growth was achieved in June after the first

treatment whereby favorable conditions for fertilization and berry set were developed. The number of berries per bunch, average bunch weight and grape yield per unit area were increased. Contents of sugar and total acids in must ranged within the level of control.

The chlorcholinechloride treatment at concentration of 2000 mg/l strongly inhibited shoot growth. Berry set was promoted, number of berries per bunch was increased and average berry weight was decreased. Grape yield was increased, whilst sugar content of must was significantly decreased, compared with a control. At lower concentration of CC1000 mg/l grape yield was significantly increased, compared with a control. The achieved yield increase did not have any negative effects on must quality. Contents of sugar and total acids ranged within the level of values for a control.

The GA<sub>3</sub> treatments resulted in contrary effects on shoot growth. At concentration of 150-mg/l average number of bunch per vine, number of berries per bunch and grape yield per vine were decreased. At concentration of 100 mg/l grape yield did not vary significantly, compared with a control, whilst sugar content of must was significantly increased.

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PRINOS I KVALITET GROŽĐA SORTE FRANKOVKA TRETIRANE  
BILJNIM REGULATORIMA RASTENJA

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R e z i m e

Istraživan je uticaj folijarne primene paklobutrazola (PK), hlorholinhlorida (CC) i giberelinske kiseline (GA<sub>3</sub>) na procese rastenja, zametanje bobica, visinu prinosa i kvalitet grožđa sorte frankovka (Limberger). Svako navedeno sredstvo je primenjivano u dve različite koncentracije. Tretiranja su obavljena dva puta u toku vegetacije: 10 do 15 dana pre i 10 do 15 dana nakon punog cvetanja.

Istraživanja su obavljena u proizvodnom vinogradu koji je u sklopu kompleksa objekta "Rasadnik" – DOO Jagodinski podrumi, a pripada A.D. "Navip". Razmak sađenja je 3 X 1,2m. Oblik stabla je modifikovana dvokraka kaznavljeva kordunica. Sastoji se iz dva stabla formirana iz osnove čokota. Na visini od 90 cm formirana su dva kraća horizontalna kraka. Na njima su smeštena po dva rodna čvora u kojima se izvodi mešovita rezidba. Istraživanja su obavljena na sorti Frankovka kalemljenoj na loznoj podlozi V. Belandieri X V. Riparia - SO<sub>4</sub> sel. Openheim.

Paklobutrazol i hlorholinhlorid su ispoljili snažno inhibitorno dejstvo na rasteње lastara. Povećan je procenat zametnutih bobica, broj bobica u grozdu, masa grozda i prinos grožđa po jedinici površine. Pri tome sadržaj šećera u širi je znatno smanjen (CC2000) ili zadržan na nivou kontrole (PK1000, CC1000). Varijanta PK500 nije ispoljila značajno dejstvo na ispitivane pokazatelje. U tretmanu GA150, prinos grožđa je smanjen. Pri nižoj koncentraciji GA<sub>3</sub>, od 100 mg/l, nije utvrđeno značajno povećanje prinosa, dok je sadržaj šećera u širi značajno povećan. Dobijeni rezultati ukazuju da efekat primene navedenih sredstava u velikoj meri zavisi od vremena tretiranja i primenjenih koncentracija.

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