Proceedings of the 7th Hungarian Congress on Plant Physiology, 2002
S5-P14

Volume 46(3-4):211-212, 2002
Acta Biologica Szegediensis
http://www.sci.u-szeged.hu/ABS

Seasonal variability in phenol content, peroxidase and polyphenoloxidase enzyme activity during the dormant season in plum rootstocks

V Szecskó[1]*, K Hrotkó[1], É Stefanovits-Bányai[2]

[1]Department of Fruit Science, Szent István University, Budapest, Hungary,[2]Department of Applied Chemistry, Szent István University, Budapest, Hungary

However the biochemical changes in the different parts of the fruit trees during the dormant season are studied by many authors. The starting point of dormancy the end of endo-dormancy and start of paradormancy is not cearly defined. The changes in enzyme activity seems to be an indicator of the end of dormancy and start of growth as descrbed by many authors (El-Mansy et al. 1969; Lasheen and Chaplin 1971; Kenis 1976; Bassuk et al. 1981; Marquat et al. 1999; Citadin et al. 2001). Few articles followed the changes during the whole rest period, starting from leaf fall. Schaefer (1983) in grapevine found the activity of peroxidase (POD) in the roots, shoots and trunk increased in autumn, maximal in December, and then decreased. The activity of catalase showed similar pattern, was greatest during the middle of dormancy, and decreased sharply towards the end of dormancy (Scalabrelli et al. 1991). There is variation among different cultivars in polyphenol oxidase (PPO) activity, and endogenous phenol content as described by Gur et al. (1988). Wang et al. (1991) found the PPO activity low in the dormant season in buds, while the phenolic content of buds was high. After budbreak PPO activity increased and phenolics decreased. There was an inverse relationship between the activities of polyphenol oxidase and peroxidase, but their conclusion is that the phenolic substances can modify the activities of these enzymes, as both inhibitors and stimulators (Wang 1991).

Materials and Methods

The following three plum rootstocks were studied: "INRA Marianna GF 8-1", "INRA Sainte Julien GF 655/2", and "Fehér Besztercei".

Samples were collected from 25th October, 2000, until 21st of February, 2001, in three weeks intervals. The enzyme activities were measured in the buds of the shoots and in the basal part of shoots (0-15 cm), the peroxidase enzyme activity by the method of Srivastava (1983), the polyphenoloxidase enzyme activity by the method of Bassuk et al (1981), and the protein content according to Bradford (1976). The results given are calculated for Unit/mg protein.

Results and Disussion

The total activity of the enzymes showed a typical seasonal pattern in all the tree cultivars (Table 1). The activity increased until November, followed by a sharp decrease until the third part when the activity started to rise again.

The maximal activity of POD measured in buds was on 29th of November in all the cultivars, then a decrease followed with a minimum in the end of January, and started to rise again in February (Fig. 1). The PPO activity also had similar pattern, but the maximum was three weeks earlier, on 8th November. A little peak can be observed also around 18th

Date of collection		25.oct. 2000.	08.nov. 2000.	29.nov. 2000.	18.dec. 2000.	10.jan. 2001.	31.jan. 2001.	21.febr. 2001.
FB	POD bud	3,73	4,98	12,34	6,36	6,51	1,93	3,92
	PPO bud	6,53	34,64	25,03	15,16	12,04	11,90	18,68
	Phenol bud	7,75	8,21	6,97	6,98	7,30	9,89	8,57
	POD cutting		1,94	1,45	6,16	2,38	0,89	3,71
	PPO cutting		0,65	0,50	1,16	0,64	0,52	0,98
	Phenol cutting	2,84	5,40	6,13	4,37	4,13	7,39	6,27
GF 655/2	POD bud	4,11	4,37	8,55	3,41	5,53	2,22	6,25
	PPO bud	17,56	28,06	11,96	19,78	15,13	11,76	48,94
	Phenol bud	9,71	8,42	7,27	9,12	7,86	11,70	9,29
	POD cutting		1,92	3,16	3,18	3,15	1,59	3,56
	PPO cutting		0,69	0,60	0,78	0,68	0,50	0,71
	Phenol cutting	2,07	5,79	3,90	4,34	3,60	4,15	4,26
GF 8-1	POD bud	4,47	2,20	6,95	2,18	2,37	0,74	1,34
	PPO bud	10,79	29,12	7,29	12,35	4,56	2,45	22,80
	Phenol bud	20,43	13,51	7,96	12,97	10,09	17,56	8,44
	POD cutting		1,32	2,34	1,88	1,44	1,00	2,05
	PPO cutting		0,87	1,10	1,89	1,00	0,80	0,96
	Phenol cutting	2,25	5,95	3,13	2,80	3,09	6,06	4,31

Table 1. Enzyme activity and phenol content of buds and cuttings of plum rootstock cultivars (Unit/mg protein).

*Corresponding author. E-mail: szecskov@omega.kee.hu

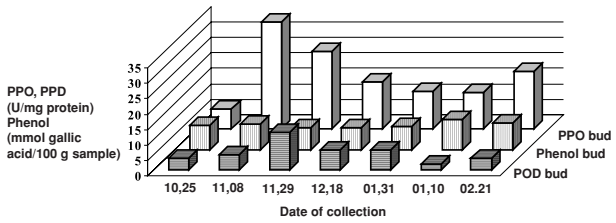

Figure 1. PPO, POD enzyme activity and phenol content of the buds of "Fehér besztercei".

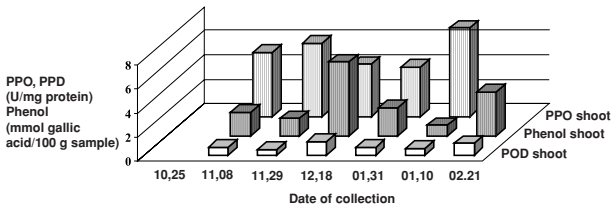

Figure 2. PPO, POD enzyme activity and phenol content of the shoots of "Fehér besztercei".

December. The amount of phenolics in buds had a relative high value especially in GF 8-1 right at the beginning of collection, on 25th October, than decreased and was minimal on 10th January, and reached the maximum on 31th January (except GF 8-1), again followed by a decrease.

The maximum PPO activity in the shoots was in 18th December for all the three cultivars with the same pattern as POD (Fig. 2). The phenol content of the base of shoots was higher than in buds, and showed different seasonal variation, as in "Fehér besztercei" the two peaks were in 29th November and 31st January, in case of GF 8-1 the first peak happened in the beginning of November, and GF 655/2 had only one peak in 8th November.

Between 25th of October and 21st of February high variations were found in the activities of POD and PPO with a similar pattern in each rootstock. Our data confirm the results of Kenis (1976), Bassuk et al. (1981) and Citadin et al (2001) who also reported an increased POD and/or PPO activity between the end of endodormancy and budbreak. The amount of phenolics changed differently.

The remarkable peak of POD activity in late November might be associated with dormancy, through oxidative stress coused by the cold. This high POD activity can be the sign, when the cold temperature cause a cold-stress expressing in more reactive oxigen species production (Purvis and Shewfelt 1993), hereby forcing POD to higher activity level. The preparation of buds to endodormancy must be completed somewhere 29th of November. After this turning point during dormancy POD activity continuously decreases, which means that the plant is in a state where cold temperatures do not cause cold stress, and increased ROS formation. A very sharp change happens then in the third period in POD enzyme activity, when supposedly the dormancy have been released, again capable to cold-stress, the buds are active, and the plant is prepared to grow.

The changes in activity of the two enzymes can be an indicator when important endogenous changes occur, and the sharp rise in February can determine the end of endodormancy.

References

Bassuk NL, Howard BH (1981) A positive correlation between endogenous root-inducing cofactor acivity in vacuum-extracted sap and seasonal changes in rooting of M26 winter apple cuttings. J Horticultural Science 4:301-312.

Bradford M (1976) A rapid and sensitive method for the quantitation of microgram quantities of protein utilizing the principle of protein-dye binding. Anal Biochem 72:248-257.

Citadin I, Raseira MCB, Augustin F, Herter F, Campos AD, Silveira CAP (2001) Relation of peroxidase, 6-Phosphoglucinolate dehydrogenase, and phosphoglucoisomerase with endodormancy phase in peach. Abstract, 5th international Peach Symposium, July 8-11, 2001. Davis, California.

El-Mansy HI, Walker DR (1969) Seasonal fluctuations of amino acids, organic acids, and simple sugars in "Elberta" peach and "Chinese" apricot flower buds during and after rest. J American Society for Horticultural Science 94:184-192.

Gur A, Gad AE, Haas E (1988) Rooting of apple rootstock clones as related to phenols and their oxdation. Acta Hort 227:160-166.

Kenis JD (1976) Some biochemical aspects of dormancy and its break in peach flower buds. I. Changes in RNase and protease activities, the activity and composition of polyphenol oxidase and peroxidase and modification of the concentration of RNA, soluble proteins and total nitrogen. Phyton, Argentina 2:133-142.

Lasheen AM, Chaplin CE (1971) Biochemical comparison of seasonal variations in three peach cultivars differing in cold hardiness. J American Society for Horticultural Science 2:154-159.

Marquat C, Vandamme M, Gendraud M, Pétel G (1999) Dormancy in vegetative buds of peach: relation between carbohydrate absorption potentials and carbohydrate concenrtation in the bud during dormancy and it release. Scientia Horticulturae 79:151-162.

Purvis AC, Shewfelt RL (1993) Does the alternative pathway ameliorate chilling injury in sensitive plant tissues? Physiologia Plantarum 88. 712-718.

Scalabrelli G, Viti R, Cinelli F (1991) Changes in catalase activity and dormancy of apricot buds in response to chilling. Acta Horticulturae 293:267-274.

Schaefer H (1983) Seasonal changes and probable importance of peroxidase activity in woody parts of Vitis. Vitis 1:1-8.

Srivastava SK, Vashi DJ, Naik BI (1983) Control of senecsence by polyamines and guanidines in young and mature barley leaves. Phytochemistry 10:2151-2154.

Wang SH, Jiao HJ, Faust M (1991) Changes in the activity of catalase, peroxidase, and polyphenol oxidase in apple buds during bud break induced by thidiazuron. J Plant Growth Regul 10:33-39.