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Post-Harvest Ethephon Application in *Taraxacum kok-saghyz* Roots

Muhammad Akbar Abdul Ghaffar[1], Jesse L. Rossington[2], Colleen M. McMahan[3] and Katrina Cornish[1,2]

[1]Department of Horticulture and Crop Science, OSU/OARDC, Williams Hall, [2]Food, Agriculture and Biological Engineering[2], OSU/OARDC,1680 Madison Avenue, Wooster, OH 44691, [3]Bio-product Research Unit, USDA-ARS, 800 Buchanan St., Albany, CA 94710

ABSTRACT

In *Hevea* rubber production, ethephon (ET) has been used to prolong latex flow for improved yield. The same method may prove effective in other rubber-producing plants such as *Taraxacum kok-saghyz* (TK). The objectives of this study were to evaluate the effect of post-harvest ET application on TK rubber production and rubber quality. Harvested roots of one year old TK plants from multiple and single clonal genotypes grown in raised beds were submerged in either ambient or cold (4°C) 1% ET solution. Rubber and latex concentrations were determined. At ambient temperature, but not at 4°C, ET pretreatment increased rubber concentration more than two times after nine days in multiple genotypes, and more than three times in clones of one genotype but not of another. The enzymatic root processing method, PENRA III, yielded twice the rubber from ET pretreated roots (multiple genotypes) than from controls, with improved rubber purity and consistent quality. However, one clonal genotype did not respond to the combined ET pretreatment and PENRA III method, indicating that genotype may influence rubber extraction efficiency. In conclusion, adaptation of these methods to a larger scale has the potential to increase post-harvest TK rubber production and overall yield.

INTRODUCTION

Ethephon (ET) and ethylene stimulation have been used to prolong latex flow and subsequently increase rubber production from *Hevea brasiliensis*, the world's dominant rubber producing plant. However, it is not known if ET can increase rubber yield in other species. This study evaluated ET application post-harvest on rubber biosynthesis, processability and quality of rubber from the alternative rubber producing species *Taraxacum kok-saghyz* (TK).

MATERIALS AND METHODS

One-year old TK soil-grown plants were harvested from multiple genotypes and single genotype clonal plants. Harvested roots were soaked for 9 days in four different treatments: distilled water only (control) at (1) ambient temperature and at (2) 4°C; and in a 1% ET at (3) ambient temperature and at (4) 4°C. After soaking, roots were dried at 50°C, and then inulin, resin and rubber content were quantified, using accelerated solvent extraction (ASE) [1]. The latex (liquid) content was also quantified [2].

The effect of post-harvest ET pretreatment on subsequent processing was evaluated on one-year old multi genotypes and replicates of two single genotypes, Clone A and B,. Roots were soaked in distilled water with and without 1% ET at ambient temperature for 9 days. Roots were then dried at 50°C. The PENRA III method, which uses hot water extraction and enzymes to extract and purify rubber, was used to extract the rubber. Rubber was quantified in all fractions by dry weight and/or ASE [1]. Rubber quality and gel content was assessed using size exclusion chromatography (SEC) with a refractive index and a laser light scattering detector [3]. Non-rubber solid contaminants were quantified by the dirt test with toluene and peptizer dissolution according to ASTM D1278-91a 412.

RESULTS AND DISCUSSION

After 9 days, the highest rubber (Fig. 1) and latex (Fig. 2) concentrations in multiple genotypes were obtained from roots soaked in the ET solution at ambient temperature (Fig.1), although some enhancement was also apparent at 4°C. One clonal line (Fig. 3) exhibited the highest rubber concentration at 4°C without ET. However, at ambient temperature, ET solution also enhanced latex concentration.

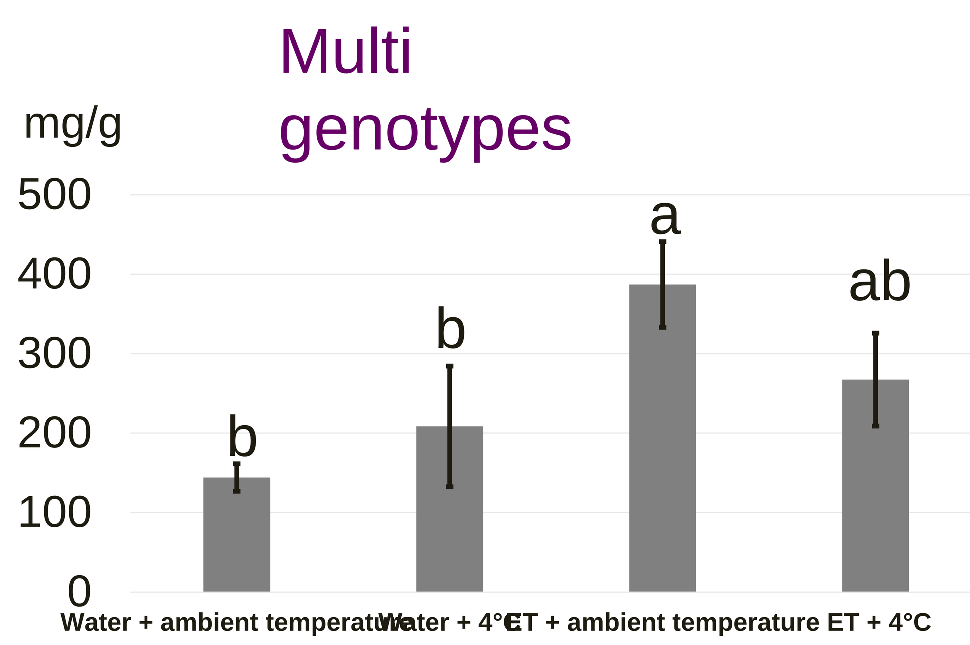

Figure 1: *Root rubber concentration after 9 days determined by ASE. Means (n=20) with the same letter(s) were not significantly different at p<0.05 (LSD test).*

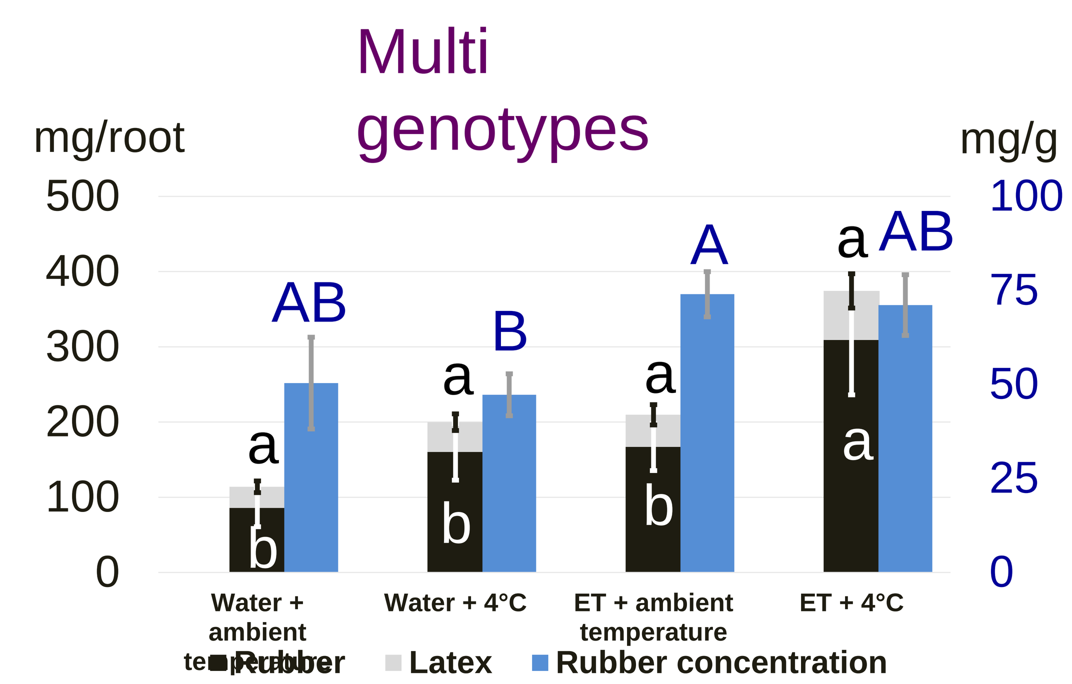

Figure 2: *Total rubber and latex (left axis) and rubber concentration (right axis) in TK roots from multiple genotypes (means of 10 ± se). Means with the same letter(s) were not significantly different at p<0.05 (LSD test).*

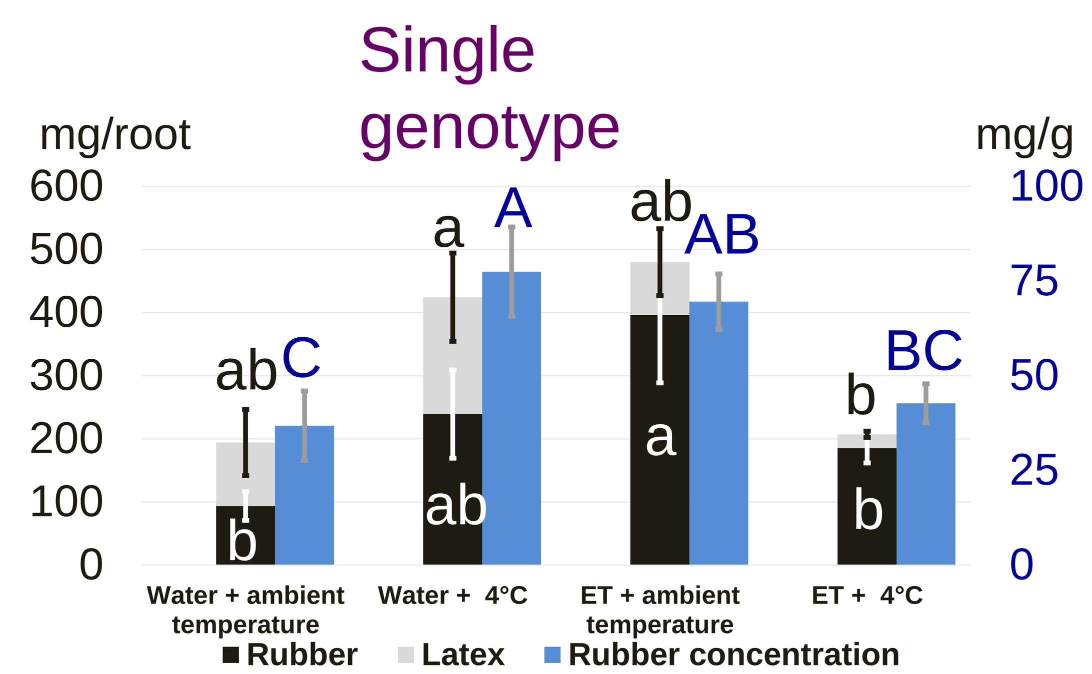

Figure 3: *Total rubber and latex (left axis) and rubber concentration (right axis) in TK roots from a clonal genotype (Clone A) (means of 5 ± se). Means with the same letter(s) are not significantly different at p<0.05 (LSD test).*

Rubber Processing Enhancement by Ethephon + PENRA III

ET pretreatment was combined with rubber processing by the PENRA III method, which uses hot water extraction and enzymes to increase yield and quality of TK rubber. For the multi genotype roots, more than twice the rubber (Fig. 4) and more floating rubber (Fig. 5a) were extracted with the combined method. However, for the single genotype roots, only one clone (A) produced a similar rubber extractable yield compared to multi genotype roots (Fig 6a and 6b). Clonal differences in ET response indicated that genotype influenced rubber biosynthesis and extraction efficiency. ET pretreatment did increase the inulin content of multiple genotype roots (Fig.5) and the mean inulin content of Clone A roots (Fig. 6B). ET pretreatment also enhanced the quality of the rubber extracted by the PENRA III extraction method by reducing the percentage of dirt (Table 1). Molecular weight, polydispersity and gel content were little changed by the ET pretreatment (Table 1).

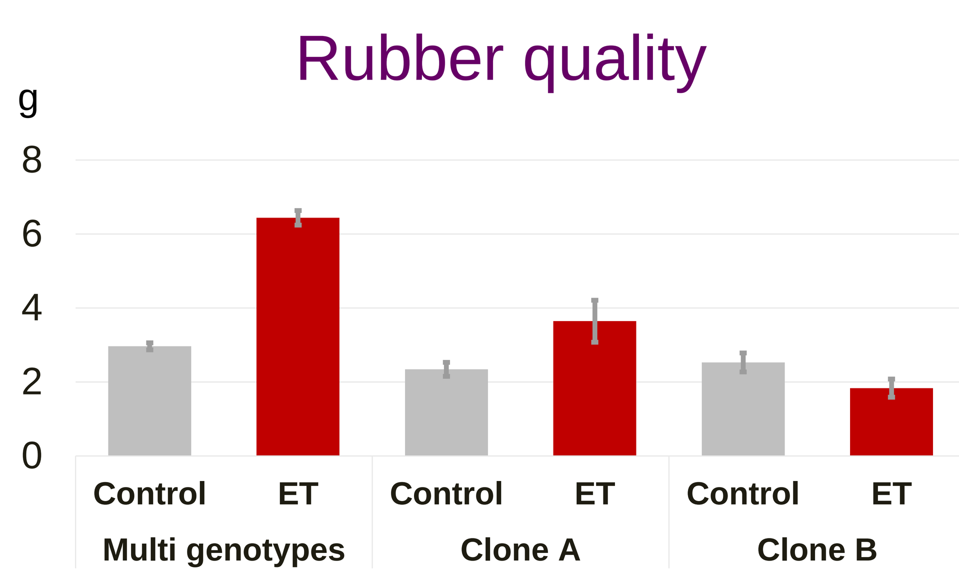

Figure 4. Rubber yield *(mg rubber/100 g dry roots) obtained by the PENRA III method. ET roots were treated with 1% ethephon (ET) for 9 days post- harvest, and then dried. Control roots were dried immediately. Each value is the mean of 3 ± se.*

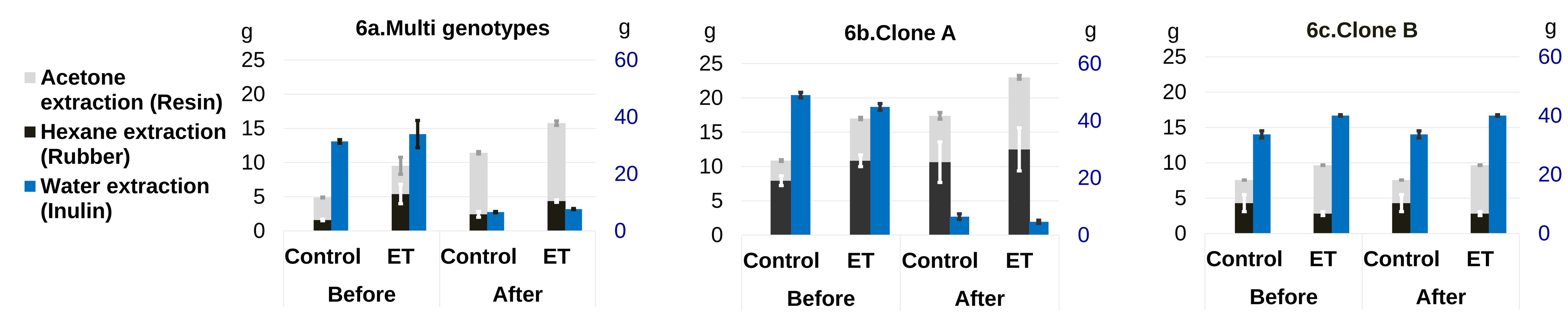

Figure 6. Yield of rubber, resin and inulin (g analyte/100 g dry roots) obtained from the ASE extraction method. Each ASE analyte value is the mean of 3 ± se.

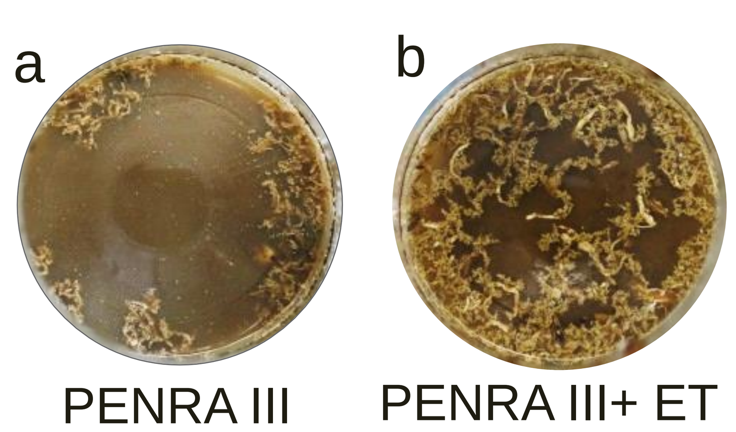

Figure 5. Floating rubber obtained from a) PENRA III and b) PENRA III + ET combined process.

Parameter	Control	ET
Dirt test (%)	6.05%	3.72
Molecular weight (g/mol)	1.2x 10^6	1.3x 10^6
Polydispersity index (M_w/M_n)	2.07	2.11
% gel	29.0	26.5

Table 1: *Rubber quality parameters measured from the rubber collected with PENRA III method, with and without (control) ET pretreatment.*

CONCLUSIONS

Post-harvest ET application improved rubber yield at ambient temperature. ET pretreatment improved yield and rubber purity of PENRA III-extracted rubber with no adverse effect on rubber quality. Rubber yield from the combined method was dependent upon the specific genotype. Adaptation of these methods to a larger scale may increase post-harvest TK rubber production and overall yield.

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