FIELD APPLICATION OF NEW ETHREL FORMULATIONS FOR EARLY COLOR ENHANCEMENT IN CRANBERRY (*Vaccinium macrocarpon* Ait.) FRUIT

Karim M. Farag, Jiwan P. Palta and Elden J. Stang
Department of Horticulture, University of Wisconsin-Madison
Madison, WI 53706

Abstract The commercial value of cranberry depends upon the anthocyanin contents. Cranberry growers in Wisconsin are attempting to enhance the color development to increase profitability and to allow earlier harvest to avoid frost damage. Ethrel spray was not able to achieve these goals consistently. Our laboratory transport studies using different systems showed the problem was mainly the impermeable nature of the fruit cuticle. Changing the wettability by using Tergitol (0.3% v/v) and by increasing the surface binding and the penetrability of Ethrel by using compounds such as ethanol, ursolic acid, lysophosphatidyl ethanolamine, phosphatidyl dimethylethanolamine, dipalmitoyl, ascorbic acid and glycerin we were able to overcome this problem. In the last three years (85-87) we have made applications of these new formulations in the field. In this paper we focus on some of the new formulations that have been used in 1987 season. With these formulations we found an increase in anthoycyanin content in the fruit by about 35-60% over the control. Marketing grade and uniformity of color were very much improved. Fruit size in the treated berries was not reduced. All treated vines appeared normal. These results show that there is a potential for the early color enhancement in cranberry fruit using these new formulations.

1. Introduction

Experimental work with ethephon has been conducted for the last decade to produce a cranberry with a bright red color (Devlin and Demoranville, 1970; Rigby et al., 1972; Eck, 1969; Shawa, 1979). Rigby et al., 1972 found that drenching the cranberry plant with ethephon in 3.74 and 7.48 K Liter/ha of H_2O will yield enhanced color development. Although Ethrel is labelled for cranberry plant for increasing the anthocyanin, the field application have yielded inconsistent results from season to season (Shawa, 1979). Cranberry fruit is known to have a relatively thick cuticle (Palta and Stang, 1983; Farag and Palta, 1987). Using isolated cranberry fruit cuticle we have found an increase in the transport of ethephon in the presence of some lipophilic compounds but ethephon alone is almost impermeable across that cuticle (Farag et al., 1985). Furthermore, the low fall temperatures (especially under Wisconsin field conditions) further limit the penetration of ethephon. The berries have the potential to produce good color if left on the vines for late harvesting (Shawa and Ingalsbe, 1968; Rigby et al., 1972). Unpredictable frost limits the late harvest practices under Wisconsin conditions, therefore farmers are forced to harvest less than ripe berries. Using the information developed under laboratory conditions, in this study we attempted to test the feasibility of using new Ethrel formulation, for early color enhancement in cranberry fruits, under field conditions.

found to increase the rate of ethylene production by intact fruits (Farag and Palta, 1988). We have also found that ursolic acid (125 ppm) increases the cuticle surface binding to ethephon (data not shown). Asorbic acid is thought to induce the fruit to produce more ethylene (Cooper et al., 1968).

These results show that cranberry fruit color can be enhanced consistently and uniformly by using new formulations of ethephon that affect not only its wettability but also surface binding and penetratibility across the fruit cuticle. Furthermore, our results demonstrate that this can be achieved by environmentally safe means. Ethanol, glycerol and ascorbic acid are known to be safe chemicals. Ursolic acid is the main fraction of the cranberry epicuticular wax (Croteau and Fagerson, 1971). Lysophosphatidyl-ethanolamine is a natural extract from the egg yolk.

Acknowledgements

We wish to acknowledge the financial support of the College of Agriculture and Life Sciences, University of Wisconsin-Madison and the Wisconsin Cranberry Growers Association. We would like to thank Dubay Cranberries, Inc., Stevens Point, Wisconsin for providing plots for field studies.

References

Cooper, W.C., Rasmussen, G.K., Rogers, B.J., Reese, P.C., and Henry, W.H. 1968. Control of abscission in agricultural crops and its physiological basis. Plant Physiol. 43:1560-1576.

Croteau, R. and Fagerson, I.S. 1971. The chemical composition of the cuticular wax of cranberry. Phytochemistry. Vol. 10. 3239-3245.

Devlin, R.M. and Demoranville, I.E. 1970. Influence of 2-chloroethylphosphonic acid on anthocyanin formation, size, and yield in Vaccinium macrocarpon cv. Early Black. Physiol. Plant. Vol. 23:1139-1143.

Eck, P. 1969. Effect of Preharvest sprays of Ethrel, Alar, Malathion on Anthocyanin content of Early Black Cranberry (Vaccinium macrocarpon Ait.) HortSci. Vol. 7 (3):224-226.

Farag, K.M., Palta, J.P., and Stang, E.J. 1985. Chemical means of enhancement of Ethrel transport across cranberry fruit cuticle. HortSci. 20:276 (Abstr.).

Farag, K.M. and Palta, J.P. 1987. Use of ethanol to enhance penetration of Ethrel across cranberry fruit cuticle:influence on partition coefficient. Plant Physiol. 83:7468 (Abstr.).

Farag, K.M. and Palta, J.P. 1988. In vivo techniques for the study of transport of various formulations of Ethrel across cranberry (Vaccinium macrocarpon Ait.) Fruit cuticle. Fourth International Symposium on Vaccinium Culture. Acta. Hort. 1988. p. 51 (Abst.).

Table 2. The effect of field applications (large scale experiment) of some Ethrel formulations on anthocyanin content and fruit size of cranberry fruit cv. 'Searles'. The anthocyanin content of the control (water) treatment was 28.2 mg/100 g fruit fresh weight. This value is the mean of 64 separate measurements. Concentrations used were: Ethrel 1000 ppm, Tergitol 0.3% v/v, ethanol 2.5%, glycerol 1.5%.

Treatments	Relative Anthocyanin Content (%)	Fruit Size (# berries/100g) (Mean ± SE)
		*
Water (Control)	100	86.7±1.54
Tergitol + Ethanol + Glycerol	98.9	82.3±2.1
Ethrel + Tergitol	107.1	87.8±1.96
Ethrel + Tergitol + ethanol	134.0	85.2±1.54
Ethrel + Tergitol + Ethanol + Glycerol	139.7	81.4±1.98

* Mean of 32 separate samples. Duplicate samples obtained at four locations with each replication. Four replications were used for each treatment.

Table 3. The effect of field applications, (small scale experiment) of Ethrel with some lipophilic compounds on anthocyanin content and fruit size of cranberry fruit cv. 'Searles'. The anthocyanin content of the control (water) treatment 17.4 mg/100 g fruit fresh weight. This value is the mean of 16 separate measurements. Concentrations used were: Ethrel 1000 ppm, Tergitol 0.5% v/v, lysocephalin 50 ppm, PDED 250 ppm, ethanol 10% v/v.

Treatments	Relative Anthocyanin Content (%)	Fruit Size (# berries/100g) (Mean ± SE)
		*
Water	100	77.7± .86
Ethrel + Tergitol	119.5	76.1±1.25
Ethrel + Tergitol + PDED	136.2	78.9± .76
Ethrel + Tergitol + Lysocephalin	150.0	76.7± .99
Ethrel + Tergitol + Ethanol	159.8	79.5± .75

* Mean of 16 separate samples.