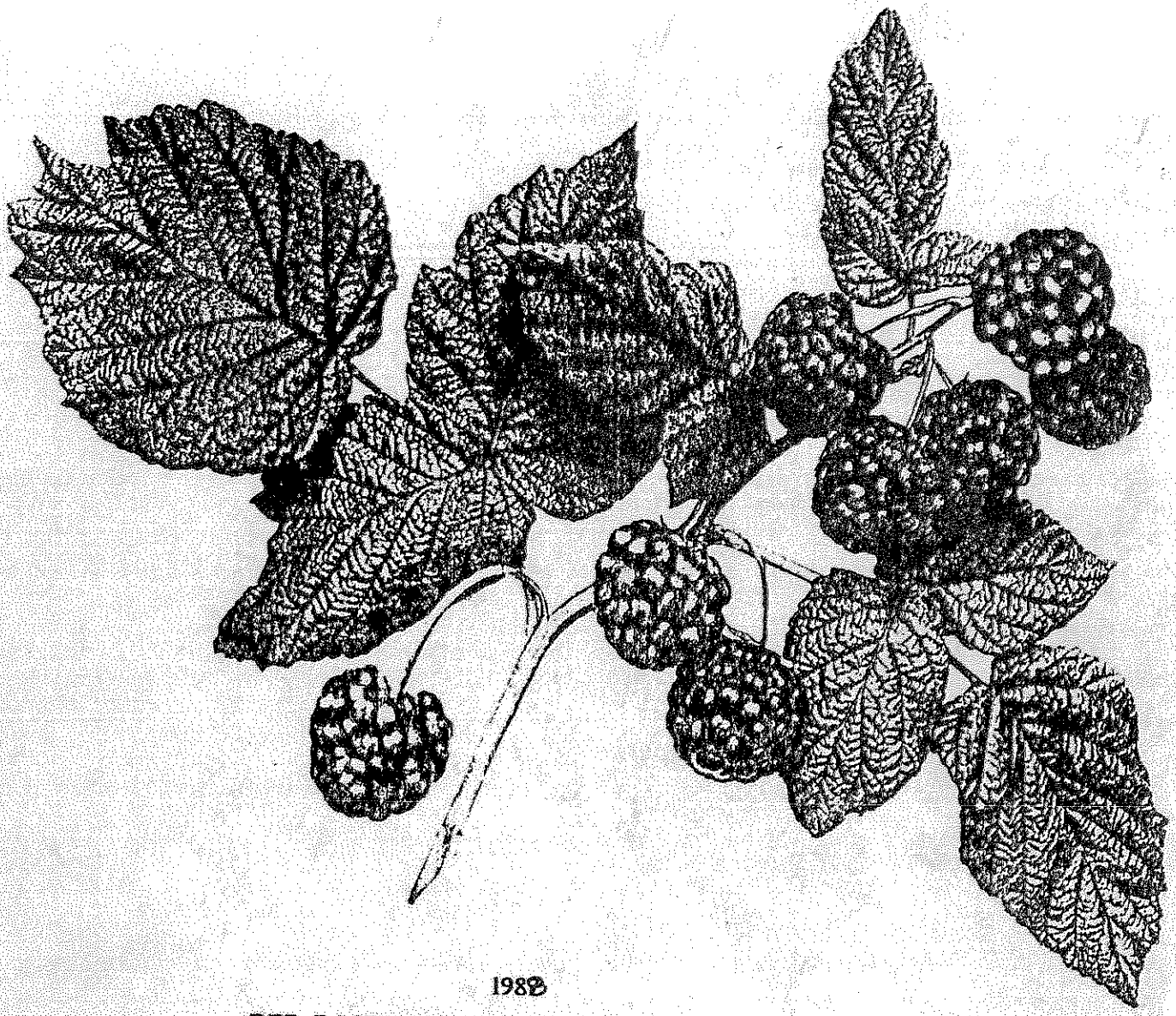

1988

RED RASPBERRY RESEARCH PROPOSALS

1987 PROGRESS REPORTS

to the

WASHINGTON STATE RED RASPBERRY COMMISSION

and

WASHINGTON RED RASPBERRY GROWERS ASSOCIATION

1987-88 [illegible]
88-89 [illegible]

WASHINGTON RED RASPBERRY COMMISSION

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TABLE OF CONTENTS

PAGE

ON-GOING PROJECTS PAGE

WSU - Puyallup Research & Extension Center

Moore, Patrick P., Jo Ann Robbins, Laura Quirie & Ron Schwinkendorf 1

Red raspberry breeding, genetics and clone evaluation

Moore, Patrick P., Robert A. Norton & Scott Cameron 10

Advanced testing of Washington State University raspberry selections (Termination Report)

Bristow, Peter & Patrick Moore 13

Development of root rot screening techniques for red raspberry

Bristow, Peter & Gwen Windom 16

The effect of waterlogging and *Phytophthora erythroseptica* on subsequent growth of red raspberry

Bristow, Peter & Gwen Windom 18

The use of irradiation to control post-harvest fruit rots of fresh red raspberries

WSU - Mt. Vernon Research & Extension Center

Norton, Robert A. & Stott Howard 22

Seek an alternative to dinoseb for primocane control in red raspberries

Howard, Stott W. & Robert A. Norton 24

Evaluation of new herbicides for use in red raspberry production

WSU - Vancouver Research Center

Cameron, J. Scott & Carol A. Hartley 27

Phenotypic stability and field performance of micro-propagated red raspberry cultivars

Shanks, Carl H., Art Antonelli, Scott Cameron & Bruce D. Congdon 29

Management of spider mites on red raspberry

Shanks, Carl H., Jr. 32

Control of insect contaminants of red raspberries by irradiation

Table of Contents Cont.

PAGE

Oregon State University

DeFrancesco, Joseph & Lloyd W. Martin 34

Relationship of blind bud to potential yield at variable cane populations and concentrations of KNO_3 spray solution

Braunworth, Bill & Garvin Crabtree 38

Suppression of primocanes in caneberries

ARS-USDA - Oregon State University

Converse, R. H. 44

Development of virus-tested red raspberry cultivars and of virus testing methods for them

NEW PROJECTS

WSU - Puyallup Research & Extension Center

Moore, Patrick P., Robert A. Norton & J. Scott Cameron 47

Advanced testing of Washington State University raspberry selections

Moore, Patrick P., Jo Ann Robbins, Laura Quirie & Ron Schwinkendorf 49

Equipment for small fruit breeding

WSU - Mt. Vernon Research & Extension Center

Cameron, Scott & Stott Howard 51

Advanced testing of new compounds for caneburning of red raspberry

WSU - Vancouver Research Center

Cameron, J. Scott & Carol A. Hartley 53

Leaf/fruit ratio and yield potential in red raspberry

Agriculture Canada

Martin, Robert R. 55

Development of a simple, rapid and sensitive test for raspberry leaf spot virus

SUMMARY

BUDGET REQUESTS

Project No.	Short Title	Lead Scientist	Amount Requested
On-going Projects			
13C-3755-7151	Raspberry breeding	Moore	$ 6,500
13C-3755-6151	Advanced testing-cultivars	Moore	-0-
13C-3761-5668	Root rot screening	Bristow	3,300
13C-3761-6688	Effects of waterlogging & root rot	Bristow	2,550
13C-3761-7669	Irradiation-fruits rots	Bristow	-0-
13K-3455-0595	Alternative to dinoseb	Norton	-0-
13C- -0740	New herbicides	Howard	-0-
13C-3555-5956	Field performance of cultivars	Cameron	3,520
13C-3543-7956	Management-spider mites	Shanks	7,740
13C-3543-6956	Insect contaminants-irradiation	Shanks	-0-
AES-688	Blind bud/potential yield	Martin	2,500
30-262	Suppression-Primocanes	Braunworth	750
58-9AHZ-3-705	Virus testing of cultivars	Converse	9,900
		Sub-total	$ 36,760
New Projects			
	Advanced testing-cultivars	Moore	$ 600
	Compounds-caneburning	Cameron	7,404
	Leaf/fruit ration-yield potential	Cameron	1,775
	Test for raspberry leaf spot virus	Martin	4,350
		Sub-total	$ 14,129
Special Project	Equipment for small fruit breeding program (Being submitted to Red Raspberry & Strawberry Commissions)	Moore	$ 43,600

PROJECT No.: 13C-3755-7151

TITLE: Red Raspberry Breeding, Genetics and Clone Evaluation

PERSONNEL: Patrick P. Moore, Assistant Horticulturist; JoAnn Robbins, Agric. Research Technologist III; Laura Quirie, Plant Technician II and Ron Schwinkendorf, Plant Technician II, WWREC, Puyallup

JUSTIFICATION:

Red raspberry breeding programs in the Pacific Northwest have been very successful, as indicated by the fact that virtually all of the commercial acreage in this region utilizes cultivars developed by these programs. A single cultivar, Willamette, accounts for approximately 70% of this acreage. This cultivar has been a consistent producer of fruit suitable for processing in the 40 years since its release.

New cultivars are needed which are better suited for fresh marketing, the most rapidly growing segment of the industry. In addition, improved resistance to Phytophthora root rot and immunity to raspberry aphid (a vector of several viruses) are needed. Recent research by Agriculture Canada scientists has demonstrated that aphid immunity effectively controls the spread of Raspberry Leafspot Virus, a virus disease found in many Pacific Northwest raspberry plantings. Finally, cultivars with improved marketable yields and fruit quality are also needed.

OBJECTIVES:

1. Develop red raspberry cultivars with improved yields and fruit quality, and resistance to root rot and raspberry aphids. Selections adapted to machine harvesting or fresh marketing will be identified and tested further.

2. Study the inheritance of fruit maturation parameters critical to fresh market shelf life (fruit weight, retention strength, firmness, pigment concentration and soluble solids).

3. Propagate and evaluate red raspberry clones for trueness to type, yield and fruit quality.

PROGRESS:

As a consequence of turnover in personnel and resulting limitations in staff, establishment of some proposed new plantings could not be accomplished.

Nine new crosses were made in 1987 between promising WSU selections and cultivars. The major emphases were to combine aphid resistance,

root rot resistance, and winter hardiness along with higher yield and desirable fruit characteristics.

A seedling planting of 1302 raspberry seedlings was established at Puyallup with material from crosses made in 1986. These seedlings will be available for selection in 1989 and 1990. Twenty seven 1986 selections and named cultivars were planted in replicated selection trials and root rot evaluation plantings at Puyallup.

Thirty eight raspberry seedlings were identified as potential selections at Puyallup. Data on these seedlings will be further evaluated and selections from this group will be propagated and grown in selection trials and root rot evaluation plantings in 1988.

The results of variety and selection evaluations at Puyallup are presented in Tables 1-5. The low yields in 1986 compared to 1987 is indicative of the degree of cold damage sustained in 1985 and 1986. Schoenman (Table 1) appears to have suffered little cold damage in the winter of 1985. Schoenman was used as a parent in many crosses in 1986 and 1987.

Many WSU selections had marketable yields comparable to Meeker, Comox and Chilcotin in 1987 (Tables 2, 3 and 4).

WSU 892 (Cherokee X Skeena) is distinguished by picking ease, growth habit and winter hardiness. The yield in 1987 was comparable to Meeker, Comox and Chilcotin (Table 3). Virus free stock of this selection is now being propagated for regional experiment station trials and grower trials. There was poor establishment of the advanced selection trial in 1987 and trials will be re-established in 1988.

Several selections in the 1984 selection trial, notably WSU 901 and WSU 904, had large fruit and yielded well (Table 3). The season of harvest varied considerably among selections in this planting. The midpoint of harvest ranged from June 25 to July 18. These selections should be useful in breeding for early and late selections.

Two promising selections evaluated in 1987 are WSU 781 (Meeker X SHRI 6820/64) and WSU 805 (SHRI 6820/54 X Meeker) (Table 5). Both of these selections were evaluated in a test of fall fruiting raspberry selections. This planting has been managed for both a floricane and a primocane crop. These two selections had high yield for the floricane crop and no buds for a primocane crop. These two selections will be propagated and placed in a selection trial in 1988 with appropriate floricane fruiting standards. The current selection trial will be managed for primocane fruiting in future years.

A replicated planting of 10 Willamette clones was evaluated in 1987. Eight of these clones were from older commercial fields and two clones from certified planting stock. The marketable yield ranged from

4.2 to 6.2 tons/acre based on 6 replicates per clone. Although there was a 2 ton/acre difference in yield, the amount of variation between clones was not statistically greater than variation from plot to plot. There were slight differences among clones in size of fruit and midpoint of harvest. These plots will be evaluated again in 1988.

Virus free propagation beds of seven varieties and three WSU advanced selections were maintained at Puyallup.

PROPOSED RESEARCH:

Crosses in 1988 will be attempted with several Rubus species to introduce root rot resistance to red raspberry. Additional crosses will be made using WSU selections. Emphasis will be on early and late selections as well as aphid resistance, cold resistance and yield.

Seedlings from 1987 crosses will be planted at Puyallup and will be available for selection in 1989 and 1990.

New selections will be made in 1988 from seedlings planted at SWRU in 1985 and 1986. These seedlings were prescreened for root rot. These seedlings will be evaluated for fresh market and/or processing qualities.

Selections made in 1987 will be planted with appropriate varieties as standards in replicated yield trials and root rot evaluation plantings at Puyallup.

Selections in previously established selection trials will be evaluated for yield, fruit weight, firmness, season of ripening and preharvest rot. Fruit will be evaluated for fresh market and/or processing quality.

The replicated planting of 10 Willamette clones will be re-evaluated in 1988.

Plants from nuclear stock propagation beds at Puyallup will be distributed to Washington certified plant propagators. A sample of plants from each bed will be fruited out at Puyallup to test for freedom from crumbliness and trueness to type.

TERMINAL DATE OF BASE PROJECT: Experiment station project currently being developed.

DURATION OF THIS PROPOSAL: Fifth year of a five-year proposal.

BUDGET:

		Current 1987-88	Proposed 1988-89
01	Timeslip labor	$4,000	$4,000
03	Supplies and services	2,000	2,000
04	Travel	-	300
07	Benefits	360 (9% of 01)	200 (5% of 01)
	Total	$6,360	$6,500

Table 1. 1984-1987 evaluations of 1982-planted raspberry selections at Puyallup.[z]

Replicated selections[z]	Marketable yield (tons/acre)				Fruit weight (g)				Fruit firmness (g)				Harvest midpoint (month/day)				Fruit rot (%)			
	1984	1985	1986	1987	1984	1985	1986	1987	1984	1985	1986	1987	1984	1985	1986	1987	1984	1985	1986	1987
Meeker	8.4	8.0	3.4	9.2 a[x]	3.5	3.2	4.4	3.2	155	226	132	116 b	7/17	7/19	7/1	7/9 a	0.5	0.4	1.1	0.1
Willamette	5.9	4.6	2.3	3.1 b	3.6	3.5	3.4	3.4	116	218	123	196 a	7/9	7/8	6/24	6/26 b	1.1	0.3	3.0	0.1
WSU 608	8.5	10.5	5.0	10.9 a	3.3	3.4	3.9	3.4	126	183	111	134 b	7/6	7/16	7/2	7/4 a	1.5	0.5	3.0	1.5
WSU 738	8.4	8.2	2.0	8.4 a	4.0	3.2	3.7	3.3	108	178	124	124 b	7/17	7/17	7/3	7/8 a	0.4	0.1	2.2	0.1
Incompletely replicated selections[y]																				
Glen Moy	2.3	6.5	-	4.5	4.0	3.8	-	3.2	118	207	-	161	7/3	7/9	-	6/27	2.4	1.3	-	0.0
Schoenman	6.2	-	8.0	8.5	3.8	-	3.6	4.7	150	-	96	139	7/18	-	7/3	7/5	2.0	-	2.4	2.2
BC 74-11-41	4.5	9.0	6.8	9.3	3.0	2.9	3.4	2.9	117	244	103	127	7/11	7/16	7/3	7/7	0.4	0.3	2.1	1.5
SCRI 6820/64	8.6	6.8	-	6.3	3.4	2.7	-	3.3	166	223	-	189	7/13	7/15	-	7/4	2.2	0.3	-	0.0
Mean	6.6	7.7	4.6	7.5	3.6	3.2	3.7	3.4	132	211	115	148	7/12	7/14	7/1	7/4	1.3	0.5	2.3	0.7

[z] Mean of three 3-hill plots.

[y] Based on one 3-hill plot.

[x] Mean separations within columns by Duncan's multiple range test, P = 0.05.

Table 2. 1985-87 evaluations of 1983 planted raspberry selections at Puyallup.

Replicated selections[z]	Marketable yield (tons/acre)			Fruit weight (g)			Fruit firmness (g)			Harvest midpoint (month/day)			Fruit rot (%)		
	1985	1986	1987	1985	1986	1987	1985	1986	1987	1985	1986	1987	1985	1986	1987
WSU 848	4.2	3.8	6.7 ab[x]	2.0	3.5	3.3 b	204	112	168	7/12	7/1	7/8 ab	0.4	1.2	0.3 b
WSU 849	5.4	5.0	6.1 ab	2.8	3.9	3.8 b	143	92	147	7/15	6/30	7/4 b	0.5	2.0	1.5 a
WSU 850	6.0	4.0	2.3 c	4.0	5.0	3.6 b	235	173	169	7/17	7/3	7/7 ab	0.1	2.2	0.6 ab
WSU 851	6.8	3.4	5.0 b	2.7	3.6	3.2 b	286	173	190	7/16	7/2	7/3 b	0.4	2.6	0.3 b
WSU 852	4.8	2.8	8.0 a	2.6	3.1	3.5 b	224	92	172	7/17	7/1	7/4 b	0.5	2.6	0.6 ab
WSU 854	11.2	2.2	8.6 a	3.0	3.2	3.5 b	245	133	173	7/19	7/3	7/7 ab	0.1	0.9	0.1 b
WSU 855	6.2	4.2	8.7 a	4.1	4.9	4.9 a	306	184	190	7/22	7/7	7/12 a	0.5	5.3	0.1 b
Incompletely replicated selection[y]															
WSU 853	9.0	4.0	7.8	3.0	3.9	2.9	204	122	139	7/20	7/2	7/10	0.1	1.0	0.2
Mean	6.7	3.7	6.7	3.0	3.9	3.6	231	135	169	7/17	7/2	7/7	0.3	2.2	0.5

[z] Mean of three 3-hill plots.

[y] Based on two 3-hill plots.

[x] Mean separations within columns by Duncan's multiple range test, P = 0.05.

Table 3. 1986-87 evaluations of 1984-planted raspberry selections at Puyallup,[z]

Selection	Marketable yield (tons/acre)		Fruit weight (g)		Fruit firmness (g)		Midpoint of harvest (month/day)		Fruit rot (%)	
	1986	1987	1986	1987	1986	1987	1986	1987	1986	1987
Chilcotin	1.3	9.1 ab[y]	3.3	3.1 d-m	81	137 j-n	7/1	7/5 i-q	10.2	0.2
Chilliwack	2.8	6.9 b-k	2.9	3.0 e-o	158	190 b-k	7/2	7/2 n-r	3.1	0.1
Comox	2.6	8.3 a-g	3.7	3.3 c-l	159	169 c-m	7/4	7/4 k-q	5.8	0.1
Meeker	1.0	8.3 a-g	2.8	3.2 d-m	84	148 g-n	6/30	7/7 h-n	3.7	0.1
Skeena	2.4	7.5 a-i	2.8	3.0 g-o	112	159 e-n	7/1	7/1 o-r	5.3	0.1
Sumner	0.5	5.7 g-l	2.4	2.4 n-o	61	109 n	6/30	7/1 o-r	6.6	0.0
Willamette	0.4	4.7 j-m	2.5	2.9 i-o	102	131 mn	6/28	6/26 s-t	7.5	0.1
ORUS 1836	-	3.9 l-m	-	2.7 i-o	-	154 f-n	-	7/6 h-o	-	0.0
SHRI 6820/41	2.6	4.7 j-m	3.1	2.9 i-o	177	206 a-f	7/6	7/8 e-l	8.5	0.3
WSU 738	1.1	9.0 ab	3.6	3.0 g-o	95	157 e-n	7/6	7/9 d-j	4.8	0.1
WSU 856	-	5.2 i-l	-	2.3 o	-	134 k-n	-	6/26 st	-	0.0
WSU 857	-	7.7 a-i	-	3.7 b-g	-	169 c-m	-	6/25 t	-	0.4
WSU 858	-	7.9 a-i	-	2.9 i-o	-	152 f-n	-	7/1 o-r	-	0.1
WSU 859	1.6	7.0 a-k	3.5	2.7 j-o	98	145 h-n	7/1	7/4 j-q	5.7	0.0
WSU 860	-	5.5 h-l	-	2.7 i-o	-	124 mn	-	7/5 i-q	-	0.1
WSU 861	3.1	8.9 a-c	2.7	2.6 k-o	98	125 mn	7/4	6/30 p-s	6.2	0.0
WSU 862	2.5	8.6 a-e	2.9	3.0 f-o	104	138 j-n	7/4	7/10 d-i	6.5	0.1
WSU 863	3.1	7.9 a-i	2.5	2.6 l-o	117	154 e-n	7/4	7/6 h-o	7.8	0.3
WSU 864	-	7.0 a-k	-	3.2 d-m	-	180 c-m	-	7/9 e-k	-	0.0
WSU 865	-	8.2 a-h	-	2.5 m-o	-	127 mn	-	7/8 e-l	-	0.0
WSU 866	1.9	7.4 a-j	3.3	4.0 b	112	196 a-i	7/1	7/6 h-o	5.5	0.0
WSU 873	4.4	6.0 e-l	3.2	2.9 i-o	61	135 k-n	7/1	7/9 e-k	3.4	0.1
WSU 874	2.6	5.8 f-l	2.5	2.5 m-o	106	140 i-n	7/5	7/11 d-h	5.3	0.6
WSU 875	-	7.3 a-k	-	2.6 l-o	-	125 mn	-	7/3 l-r	-	0.1
WSU 876	2.4	6.4 b-l	2.6	2.9 i-o	79	110 n	7/1	6/29 r-t	6.1	0.2
WSU 877	-	7.7 a-l	-	3.3 b-k	-	245 a	-	7/18 a	-	0.0
WSU 878	4.8	8.4 a-f	3.5	2.7 j-o	113	163 d-n	7/10	7/12 c-g	1.9	0.1
WSU 880	-	6.5 b-l	-	3.2 d-m	-	180 c-m	-	7/10 d-i	-	0.7
WSU 882	-	5.3 i-l	-	3.1 e-n	-	175 c-m	-	7/5 i-p	-	0.2
WSU 885	-	6.2 c-l	-	3.8 b-d	-	188 b-l	-	7/12 b-f	-	0.8
WSU 886	-	6.7 b-k	-	3.0 h-o	-	158 e-n	-	7/14 a-d	-	0.9
WSU 887	2.3	6.8 b-k	2.7	2.9 i-o	107	176 c-m	7/5	7/11 d-h	5.7	0.2
WSU 888	-	6.2 d-l	-	3.4 b-j	-	192 a-j	-	6/30 q-t	-	0.0

Continued

Table 3. Continued

Selection	Marketable yield (tons/acre)		Fruit weight (g)		Fruit firmness (g)		Midpoint of harvest (month/day)		Fruit rot (%)	
	1986	1987	1986	1987	1986	1987	1986	1987	1986	1987
WSU 889	-	6.4 b-l	-	3.5 b-h	-	164 d-n	-	7/16 a-c	-	0.2
WSU 892	3.2	8.1 a-h	3.6	3.7 b-e	173	162 d-n	7/1	7/2 n-r	2.4	0.0
WSU 893	2.5	6.5 b-l	3.5	3.5 b-h	102	155 e-n	7/4	7/2 n-r	4.0	0.2
WSU 894	-	2.3 m	-	2.7 i-o	-	157 e-n	-	7/4 j-q	-	0.6
WSU 895	3.1	7.5 a-i	2.7	3.1 e-o	110	153 f-n	7/4	7/7 g-n	3.4	0.4
WSU 896	3.1	7.8 a-i	3.3	4.0 bc	102	175 c-m	7/4	7/4 j-q	5.1	0.2
WSU 898	-	5.8 f-l	-	2.9 i-o	-	132 l-n	-	7/5 i-q	-	0.2
WSU 899	2.6	6.4 c-l	3.1	2.9 i-o	100	128 mn	7/4	7/5 i-q	4.0	0.1
WSU 900	-	8.8 a-d	-	2.9 i-o	-	241 ab	-	7/16 a-c	-	0.0
WSU 901	2.8	8.6 a-e	4.1	5.3 a	185	222 a-c	7/4	7/3 m-r	7.4	0.3
WSU 902	3.6	7.4 a-j	3.8	3.3 c-l	158	245 a	7/9	7/10 d-h	3.8	0.1
WSU 903	-	6.6 b-k	-	4.9 a	-	211 a-e	-	7/7 g-n	-	1.6
WSU 904	-	8.3 a-g	-	5.3 a	-	236 ab	-	7/9 e-k	-	0.2
WSU 905	-	7.4 a-j	-	2.9 i-o	-	164 d-n	-	7/8 e-l	-	0.0
WSU 907	-	4.6 k-m	-	3.1 e-o	-	146 h-n	-	7/5 i-q	-	0.0
WSU 908	4.0	9.6 a	3.7	3.4 b-i	125	216 a-d	7/12	7/17 ab	3.7	0.1
WSU 909	3.2	8.0 a-h	3.6	3.7 b-f	103	204 a-g	7/5	7/8 f-m	4.2	0.3
WSU 911	-	7.9 a-i	-	4.0 bc	-	197 a-h	-	7/13 b-e	-	0.1
Mean	2.6	7.0	3.1	3.2	114	167	7/4	7/6	5.3	0.2

[z] Mean of two 4-hill plots.

[y] Mean separations within columns by Duncan's multiple range test, P = 0.05.

Table 4. 1987 evaluation of 1985 planted summer fruiting raspberry selections at Puyallup.[z]

Selection	Marketable yield (tons/acre)	Fruit weight (g)	Fruit firmness (g)	Harvest midpoint (month/day)	Fruit rot (%)
Meeker	7.5 b-g[y]	2.8 c-g	106 c-e	7/4 c-e	0.0
Skeena	7.1 b-h	3.2 a-d	126 a-e	6/25 ij	0.2
Willamette	5.2 g-i	3.2 a-d	118 a-e	6/24 jk	0.0
BC 72-1R-7	7.9 b-f	2.7 d-g	121 a-e	6/24 i-j	0.1
SCRI 6820/64	9.6 ab	2.8 c-f	148 ab	6/27 g-j	0.1
WSU 738	10.8 a	3.7 a	113 c-e	7/6 c	0.0
WSU 835	4.8 g-i	2.5 e-g	102 de	7/2 d-f	0.0
WSU 844	7.2 b-h	3.1 b-e	126 a-e	6/24 ij	0.1
WSU 912	5.9 e-i	2.2 fg	103 de	6/27 h-j	0.1
WSU 913	9.0 a-d	3.0 b-e	133 a-d	7/7 c	0.4
WSU 914	7.4 b-g	3.3 a-c	150 a	6/26 ij	0.1
WSU 915	8.7 a-d	2.7 d-g	105 de	7/7 c	0.2
WSU 916	6.7 d-h	3.5 ab	117 b-e	6/30 e-h	0.1
WSU 917	4.6 hi	2.8 c-f	138 a-c	7/4 c-e	0.2
WSU 918	7.4 b-g	2.8 c-f	97 e	7/4 c-e	0.1
WSU 919	6.3 d-i	2.7 c-g	123 a-e	6/28 g-i	0.2
WSU 922	5.0 g-i	2.8 c-g	117 b-e	6/30 f-h	0.0
WSU 923	7.5 b-g	3.6 ab	125 a-e	6/28 g-i	0.1
WSU 925	6.9 c-h	2.7 c-g	111 c-e	6/30 e-h	0.2
WSU 926	4.9 g-i	2.7 d-g	106 c-e	6/21 k	0.3
WSU 927	6.6 d-h	3.1 a-d	127 a-e	6/30 e-h	0.0
WSU 928	8.0 b-e	2.9 c-e	151 a	7/11 b	0.0
WSU 929	3.7 i	2.2 g	98 e	7/1 e-g	0.1
WSU 930	9.4 a-c	3.5 ab	110 c-e	7/16 a	0.1
WSU 931	5.8 e-i	2.7 c-g	122 a-e	6/29 f-h	0.0
WSU 933	8.8 a-d	3.4 ab	119 a-e	7/5 cd	0.3
Mean	7.0	2.9	120	7/1	0.1

[z] Mean of two 4-hill plots.

[y] Mean separations within columns by Duncan's multiple range test, P = 0.05.

Table 5. 1987 summer crop evaluation of 1985 planted fall fruiting raspberry selections at Puyallup.[z]

Selection	Marketable yield (tons/acre)	Fruit weight (g)	Fruit firmness (g)	Harvest midpoint (month/day)	Fruit rot (%)
Heritage	1.1 e[w]	1.8 d	91 b	7/2 a	0.0
ORUS 2033	3.3 d	2.2 cd	129 ab	7/2 a	0.6
WSU 774	7.7 c	2.7 bc	135 a	6/25 b	0.2
WSU 781[y]	12.1 a	3.2 b	114 ab	7/1 a	0.3
WSU 805[x]	10.4 b	4.0 a	136 a	7/2 a	0.3
Mean	6.9	2.8	121	6/30	0.3

[z] Mean of two 4-hill plots.

[y] Meeker X SHRI 6820/64, comments - large fruit, weak laterals, fruit acid.

[x] SHRI 6820/54 X Meeker, comments - strong canes, large fruit, fruit acid.

[w] Mean separations within columns by Duncan's multiple range test, P = 0.05.

PROJECT NO.: 13C-3755-6151

TITLE: Advanced Testing of Washington State University Raspberry Selections

PERSONNEL: Patrick P. Moore, Assistant Horticulturist, WWREC, Puyallup
Robert A. Norton, Horticulturist, NWREC, Mt. Vernon
J. Scott Cameron, Assistant Horticulturist, SWRU, Vancouver

JUSTIFICATION:

The development of a new raspberry cultivar is a long-term process requiring the cooperative efforts of both university and industry personnel. A key step in the evaluation of promising selections is to test their performance against standard cultivars in several locations throughout the region in which they are to be grown. Accurate records of the yield, fruit quality, and susceptibility to pests in these locations are important in the decision to release or discard a promising selection. In addition, estimates of the effect of location on expression of these characters will determine which ones can be effectively improved in the breeding program.

OBJECTIVES:

A. To establish and maintain replicated plantings at WWREC in Puyallup, NWREU in Mt. Vernon and SWRU in Vancouver of advanced selections from the Washington State University and other regional raspberry breeding programs.

B. To measure yield, fruit quality, and susceptibility to pests in these selections as part of the ongoing cultivar development process.

C. To measure genotype by environment interactions in these selections for traits under improvement.

PROGRESS:

Plantings of 5 WSU advanced selections and 3 standard varieties were established in all 3 locations in spring, 1983. All plantings were maintained as individual hills and canes were pruned to 1.7 m. Irrigation and fertilization schedules were adjusted to the local requirements of each planting. Three WSU selections were eliminated from further consideration after the 1986 harvest and were not harvested in 1987.

Harvest data for 1985 to 1987 averaged across the 3 locations are given in Table 1. Over the three year period WSU 738 and WSU 608 had the highest marketable yield. In 1987 all genotypes had higher yield

than Willamette. There were no significant differences among the other genotypes.

WSU 738 consistently had the largest fruit weight, in 1987 WSU 738 and Chilcotin had the largest fruit. In 1987 WSU 738 ripened in the same season as Meeker, both of which were later than Chilcotin, WSU 608 and Willamette. Preharvest fruit rot was low for all genotypes averaged across all locations. The amount of rot was higher at Puyallup than at other locations. WSU 608, WSU 738 and Willamette had the highest amount of rot at Puyallup in 1987.

Plants of Willamette, WSU 608 and WSU 738 were fruited out at Puyallup to evaluate crumbliness. Pollen was collected from plants with crumbly fruit and from plants with normal fruit. This pollen will be evaluated for the proportion of normal pollen.

WSU 738 is recommended for variety release pending evaluation of the grower trials conducted this year.

Machine harvesting trials of WSU 608 and Willamette conducted in Vancouver in 1987 were disappointing. WSU 608 yielded 75% of Willamette when canes were woven and equal to Willamette when canes were topped.

New plantings were established at Mt. Vernon and Vancouver. However survival, especially of WSU 892 at Vancouver, was poor. These plantings will be terminated and new plantings initiated.

PROPOSED RESEARCH:

A new planting will be initiated as a new project.

TERMINAL DATE OF BASE PROJECT: June 30, 1988

DURATION OF PROPOSAL: Terminated 1988

Table 1. 1985-1987 evaluations of WSU advanced red raspberry selection.[z]

	Marketable yield (tons/acre)			Fruit weight (g)			Midpoint of harvest			Fruit rot (%)		
Selection	1985	1986	1987	1985	1986	1987	1985	1986	1987	1985	1986	1987
Chilcotin	5.6	5.3	10.0a[y]	3.3	3.9	3.7ab	7/11	7/3	7/4	0.3	0.8	0.2
Meeker	6.0	5.5	9.9a	3.1	3.8	3.3b	7/15	7/4	7/7	0.1	0.6	0.1
Willamette	5.5	4.7	7.2b	3.4	3.5	3.4b	7/8	6/29	7/1	0.1	1.0	0.4
WSU 608	6.7	6.3	9.4a	3.3	3.7	3.4b	7/14	7/4	7/3	0.2	1.8	0.6
WSU 738	6.4	5.1	11.0a	4.1	4.6	4.0a	7/18	7/5	7/9	0.6	2.0	0.4
Genotype by location	NS	NS	NS	NS	NS	NS	NS	**	NS	NS	**	*

[z] Mean of 3 locations (Mount Vernon, Puyallup and Vancouver), 3 replications per location.

[y] Mean separations within columns by Duncan's multiple range test, P = 0.05.

PROJECT NO.: 13C-3761-5668

TITLE: Development of root rot screening techniques for red raspberry

PERSONNEL: Peter Bristow, Associate Plant Pathologist, WWREC, Puyallup
Patrick Moore, Assistant Horticulturist, WWREC, Puyallup

JUSTIFICATION:

Root rot, caused by *Phytophthora erythroseptica* and possibly other *Phytophthora* spp., is a serious problem throughout the red raspberry production areas of the Pacific Northwest. While the fungicide metalaxyl effectively controls this disease, the development of root rot resistant cultivars remains the most promising long term solution to the problem. Genotypes, which have been identified as root rot resistant, are for one reason or another not commercially acceptable. Thus, one of the major objectives of the red raspberry breeding program is to combine root rot resistance with desirable horticultural traits.

Growing seedlings in naturally infested field sites to identify resistant plants is both time consuming and limits the number of seedlings that can be tested. A technique for inoculating seedlings with the pathogen under greenhouse conditions has been used for three seasons. Seedlings surviving this test have been placed out in naturally infested soil at the Southwestern Washington Research Unit in Vancouver to confirm their resistance and to begin the process of evaluating them for horticultural characteristics. Seedlings from crosses which could yield cultivar quality material have been included in tests each year. In addition, open-pollinated seedlings from different *Rubus* spp. have been included to identify other potential sources of resistance that may be used in the breeding program.

OBJECTIVES:

1. To develop a rapid, reproducible screening technique for evaluating root rot resistance in raspberry seedlings and plants derived from rooted cuttings.

2. To determine the inheritance of resistance to *Phytophthora erythroseptica* in red raspberries.

3. Evaluate open pollinated progenies of native and introduced *Rubus* spp. for potential sources of root rot resistance.

PROGRESS:

The six plants selected in 1986 after having survived the greenhouse inoculation test plus two years in naturally infested soil at SWRU were propagated and planted out for advanced testing in replicated plots at Puyallup. The cultivar 'Cherokee', previously identified as a source of root rot resistance, was the pollen parent of five of the six genotypes selected.

Of the seedlings from cultivar-type crosses tested in 1985, 276 remained symptom free after two years in the field. This planting will be carried over for another year so the plants can be thoroughly evaluated for horticulturally desirable characteristics before selections are made.

Survivors from the 1986 greenhouse seedling test were evaluated for root rot for the first time in the field in 1987. Of the 1,023 seedlings planted out (in early July, 1986), 748 were still alive in July 1987. Only 8% of the 748 plants exhibited any symptoms of root rot in 1987. This planting will also be evaluated again for root rot in 1988 as well as horticultural traits. Many seedlings from this planting are from *Rubus* spp. other than red raspberry and may represent sources of root rot resistance different from that found in the cultivar 'Cherokee'.

One major concern with the greenhouse seedling test is that to date only a single isolate of the pathogen *Phytophthora erythroseptica* has been used for all tests. During May 1987, a research scientist from the Scottish Crop Research Institute who specializes in root diseases caused by *Phytophthora* spp. spent three weeks working with us in Puyallup. The main objectives of her visit were to exchange current research information on Phytophthora root rot (which is a newly recognized disease of red raspberry in Europe) and to share with us techniques the group she works with are using for isolating *Phytophthora* spp. from infected roots. A portion of this grant for 1987 helped support her visit.

As a direct result of her visit, 100+ isolates of *Phytophthora* were obtained from seven different red raspberry fields in western Washington and the lower Fraser River Valley in British Columbia. Preliminary results suggest that many of these isolates may be similar to one another. Research continues to identify each of these cultures. Also, it has not yet been determined which of these isolates can attack roots of red raspberry.

PROPOSED RESEARCH:

1. Survivors from the previous seedling inoculation tests which are in field plantings at the Southwestern Washington Research Unit will be evaluated for root rot and horticultural characteristics in

1988. The most promising of these plants will be selected for propagation and advanced testing.

2. The seedling inoculation test will be modified in order to test for root rot resistance in plants derived from rooted cuttings. Plants grown from rooted cuttings of a susceptible (Skeena) and a resistant (Cherokee) cultivar will be used. Age of the rooted cutting (plant size), inoculum concentrations and type of inoculum (mycelium vs. zoospores) will be varied to determine the most satisfactory combination for differentiating resistant and susceptible genotypes.

3. The following additional research is proposed for the coming year. Rooted cutting plants of a susceptible cultivar will be inoculated with the different fungal isolates to determine which ones are capable of causing root rot.

DURATION OF THE PROJECT:

0668 and 0640; June 30, 1988 expiration for both. Duration of this proposal one year; March 1988 to March 1989.

BUDGET:

		Current 1987-88	Proposed 1988-89
01	Wages	$1,200	$2,400
03	Supplies and Services	262	420
04	Travel	300	285
05	Computing Services	30	75
07	Benefits (5% of Item 01)	108*	120
	Total	$1,900	$3,300

* for 1987-8 (9% of Item 01)

PROJECT NO.: 13C-3761-6688

TITLE: The effects of waterlogging and *Phytophthora erythroseptica* on subsequent growth of red raspberry

PERSONNEL: Peter Bristow, Associate Plant Pathologist WWREC, Puyallup

Gwen Windom, Agricultural Research Technologist III, WWREC, Puyallup

JUSTIFICATION:

During the winter there is a high likelihood of the soil becoming saturated in many red raspberry fields in western Washington. Based on field observations and comments from cooperative Extension agents and growers, it appears that red raspberries are sensitive to high soil moisture during the late winter and early spring. This time corresponds with the resumption of root growth. At this time, even short periods of flooding may cause significant injury to roots. The consequences of root injury are not observed until cane growth (both lateral production on floricanes and new primocanes) exceeds the ability of the root system to support that growth. Premature senescence of floricanes and reduced vigor of primocanes are symptoms associated with a poor root system. These symptoms are virtually the same as those of root rot caused by *Phytophthora erythroseptica*. The relative importance of flooding by itself in causing damage and how flooding and root rot interact, are not well understood. For this reason a study is proposed to look at the effects of flooding both in the absence and presence of *P. erythroseptica*.

OBJECTIVES:

This study will examine what impact the time of flooding and also the duration of flooding have on both non-inoculated and inoculated plants. Effects of treatment on subsequent cane growth, root development and severity of root rot will be determined.

PROPOSED RESEARCH:

The experiment will be conducted in a covered screenhouse where potted plants will be subjected to ambient air temperatures but soil moisture can be controlled. The experimental protocol will be to start plants of three cultivars (Meeker, Willamette and Sumner) in pots this coming spring (1987) and allow them to produce 1-2 canes per pot. In October we will inoculate the soil in one-half of the pots with the root rot fungus *P. erythroseptica*. All plants will be allowed to go dormant. Then in January 1988 flooding treatments will start; through the winter at 2-3 week intervals groups of plants will be exposed to soil flooding

to saturate the soil in the pots. The period of saturation will vary up to a maximum of 16 days. Following treatment the pots will be permitted to drain naturally to allow the water content of the soil to return to that of the untreated checks. There will be two types of checks that will not be flooded at any time; a) non-inoculated and b) inoculated.

In the spring and summer of 1988 we expect that certain plants will grow normally compared to the untreated checks, whereas others are likely to grow poorly or to die. Data will be collected on floricane performance, primocane growth and upon termination of the experiment on root development and root rot severity.

PROGRESS:

Disease free tissue culture propagated plants of the three cultivars Willamette, Meeker and Sumner were transplanted in late spring 1987. Each plant was transplanted into steamed soil in a two-gallon plastic pot. One-half of the plants of each cultivar are currently being inoculated with the root rot fungus *Phytophthora erythroseptica*. The remainder of the plants will not be inoculated. It is anticipated that the experiment will proceed as outlined above in the "Proposed Research" section.

DURATION OF BASE PROJECT: Project No. 0518, June 30, 1988

DURATION OF THIS PROPOSAL:

Second year of the two year project. Until March 31, 1988.

BUDGET:

	Item	1987-88	1988-89
01	Wages	$ 500.00	$1,525.00
03	Supplies and Services	1,650.00	900.00
05	Computing Services		50.00
07	Benefits (5% of Item 01)	60.00*	75.00
	Total	$2,210.00	$2,550.00

* for 1987-88 (9% of Item 01)

PROJECT NO.: 13C-3761-7669

TITLE: The use of irradiation to control post-harvest fruit rots of fresh red raspberries

PERSONNEL: Peter R. Bristow, Assoc. Plant Pathologist, WWREC, Puyallup

Gwen E. Windom, Ag. Res. Tech. III, WWREC, Puyallup

JUSTIFICATION:

Over the last six years the volume of red raspberries shipped fresh has increased dramatically. One of the major factors limiting the shelf-life of this extremely perishable commodity are fungal rots that develop after harvest. Fungicides applied between flowering and harvest, picking fruit before it becomes fully ripe, refrigerated storage and atmospheres enriched with carbon dioxide have each contributed to extending the keeping quality of existing cultivars.

Irradiation, which is used extensively to sterilize medical equipment and supplies in the United States and food products in many countries around the world, has the potential of improving the shelf-life and quality of fresh red raspberries. Pacific Northwest Laboratory (a division of Battelle) is conducting a program for the U. S. Department of Energy to evaluate the benefits of using irradiation on Northwest agricultural products. Washington commodities already participating in the program include: apples, cherries, asparagus, hay and hides.

OBJECTIVES:

To determine if irradiation will extend the shelf-life of fresh red raspberries by reducing post-harvest fungal fruit rots when used alone and in combination with pre-harvest fungicides.

PROPOSED RESEARCH:

Fresh red raspberries, harvested from fungicide sprayed and untreated plots, will be irradiated. A range of irradiation doses will be tested to determine the effective dosage. Irradiated and nonirradiated fruit will be held in refrigerated storage for periods up to 30 days. Weight loss, color change, appearance quality and mold development will be assessed at various times during cold storage.

PROGRESS (Final Report):

Red raspberries hand harvested for the fresh market from a commercial farm were used for these tests. All fruit was treated with fungicides before harvest so fruit was harvested on two dates to provide

different intervals between the final application and harvest. Berries received an initial evaluation and were placed in a 38°F walk-in cooler within several hours of harvest. The following day all berries (fruit to be irradiated as well as that of the non-irradiated checks) were transported (in iced insulated containers) to the irradiator at Pacific Northwest Laboratories in Richland. Berries were exposed to 50, 75, 100, 150 and 200 kilorads of gamma radiation from a Cobalt 60 source by varying the exposure time. Irradiation was carried out at room temperature. Fruit was brought back to Puyallup and returned to refrigerated storage the same day. Rot, color and other fruit quality characteristics were evaluated every 2-3 days until 21 days after harvest at which time rot incidence and fruit firmness were determined.

Radiation doses as high as 200 kilorads (twice the level currently permitted for food treatment by the U.S. Food and Drug Administration) did not extend the shelf life of 'Chilcotin', 'Meeker' or 'Willamette' red raspberries. The incidence of fungal rot after 21 days refrigerated storage was the same for non-irradiated and irradiated fruit regardless of radiation dose (Table 1 appendix). The 150 and 200 kilorad doses may have delayed the appearance of mold by 2-3 days, but the data have not been analyzed yet.

Berries continued to develop red color during storage, becoming darker with time. Irradiation had no impact on color development. The only exception to this was the retardation of color formation in drupelets thought to be injured by heat.

At harvest heat injured drupelets are very light in color compared to those making up the rest of the berry. This uneven ripening imparts a mottled appearance to the fruit. Radiation doses of 75 kilorads or greater accentuated the mottled appearance by apparently further retarding pigment formation in the injured drupelets. The intensity of this mottling was scored (at the end of the storage period) on a scale of 1 to 3 where 1 was the least noticeable mottling. Even on non-irradiated berries injured drupelets are lighter in color than uninjured ones. The mottling-radiation phenomonen was noticed on 'Chilcotin' and 'Meeker' fruit from the second harvest but not on 'Chilcotin' or 'Willamette' fruit from the first harvest where very few drupelets showed symptoms of heat damage.

The mottling was very evident under fluorescent lighting, but almost negligible under bright incandescent lamps or sunlight. Because color was assessed under bright photoflood lamps, mottling had no impact on overall color.

Fruit firmness, measured at the end of the 21-day storage period, was not influenced by radiation dose except for 'Chilcotin' berries from the second harvest date. For those berries firmness decreased slightly at the 150 and 200 kilorad doses.

Once picked, fruit began to dehydrate and lose weight; however, irradiation had no influence on the rate of weight loss. Covering berries in the ventilated cups with cellophane immediately after harvest reduced weight loss in storage by one-half. Storing fruit under cellophane slightly increased the incidence of fruit rot.

In these trials irradiating fresh red raspberries did not maintain quality or extend the shelf life of this perishable commodity. Based on these results, it appears that this technology is not suitable for this crop.

TERMINATION DATE OF BASE PROJECT:

March 31, 1988.

Appendix Table 1. The impact of radiation on the quality of fresh red raspberries after 21 days in refrigerated (38°F) storage.

Harvest date	Cultivar	Radiation dose (kilorad)	After 21 days refrigerated storage: Weight loss, %		Rot, %		Firmness, g		Mottling rating[z]	
			Uncovered	Covered[y]	Uncovered	Covered	Uncovered	Covered	Uncovered	Covered
June 23	Chilcotin	0	13.9	7.8	72	78	110	103	-	-
		50	14.5	8.3	66	86	123	94	-	-
		75	13.8	7.6	71	80	100	103	-	-
		100	14.8	8.4	71	81	99	89	-	-
		150	15.1	7.6	69	79	107	101	-	-
		200	15.9	8.3	70	80	109	99	-	-
	Willamette	0	12.7	6.9	35	37	112	101	-	-
		50	12.7	7.6	30	39	111	115	-	-
		75	10.6	6.7	23	39	117	106	-	-
		100	11.8	7.4	26	37	112	117	-	-
		150	13.3	7.6	33	38	106	105	-	-
		200	13.2	8.2	25	32	108	101	-	-
June 30	Chilcotin	0	10.8	5.9	49	62	83	73	1.0	1.0
		50	11.6	6.1	43	62	69	78	1.0	1.0
		75	11.0	5.8	49	64	64	69	1.1	1.0
		100	11.4	6.4	43	59	68	79	1.3	1.6
		150	11.3	6.5	50	57	53	51	2.1	2.1
		200	11.7	6.3	37	58	48	53	2.6	2.6
	Meeker	0	10.5	5.8	31	40	85	72	1.0	1.0
		50	10.8	5.7	28	42	76	72	1.0	1.0
		75	10.8	5.5	31	40	79	72	1.1	1.3
		100	10.6	5.9	30	43	86	69	1.3	1.4
		150	11.1	6.2	32	39	82	67	1.9	2.3
		200	11.7	6.1	30	38	76	74	2.5	2.6

[z] Mottling rated on a scale of 1 to 3. 1=least noticeable; 3=very noticeable.

[y] Cellophane (clear) placed over berries in cups immediately after harvest.

PROJECT NO.: 13K 3455 0594

TITLE: Seek an Alternative to Dinoseb for Primocane Control in Red Raspberries

PERSONNEL: Robert A. Norton, Horticulturist and Stott W. Howard, Weed Scientist, Northwestern Washington Research and Extension Center, Mount Vernon, Washington

JUSTIFICATION:

The recent emergency cancellation of all uses of dinoseb has caused a major upheaval in the raspberry industry and has resulted in a frantic search for an adequate replacement. In the case of the raspberry and blackberry industries, dinoseb has been used rather extensively for more than 10 years for the temporary suppression of primocanes in the Spring. Extensive research by Norton, Crandall and others showed that dinoseb was the only effective material for "cane burning" or "cane control", although many different additives could influence it's effectiveness. Paraquat, also a contact herbicide, was found to be ineffective in killing back the flush of new canes.

The research outlined is necessary to provide data for registration of replacement methods and/or materials to alleviate this problem.

OBJECTIVES:

1. To find methods and/or materials for the temporary inhibition of primocane growth in red raspberry.

2. To prepare documentation for eventual registration of alternatives to dinoseb.

PROGRESS REPORT:

Approximately 20 cane control treatments were applied to replicated plots in commercial 'Willamette' raspberry fields in Skagit and Whatcom counties of Washington. Based on discussions with cooperators, similar treatments were applied by Drs. Braunworth and Freeman in Oregon and British Columbia. These treatments included herbicides, caustic fertilizer compounds, flame and hand cane removal. In addition to materials and treatment rates, carriers and timing of application were studied. The plots were evaluated for primocane control and crop injury one and three weeks after application samples were taken from selected plots for residue studies. Cane measurements are being made in October/November to determine effect on cane growth for the entire season.

Though a final report is not completed, the following general statements can be made:

1. Lactofen, oxyfluorfen and Endothall showed promise as being as effective as dinoseb.

2. Paraquat, diquat, N=Tac, Phosphoric acid, diesel oil, Uran 32, and propane flame were ineffective at the rates used.

3. Additional studies will be needed with lactofen and oxyfluorfen on timing, rate and frequency of application before commercial registration will be successful. (These studies are proposed in a project by Cameron and Howard which is contained elsewhere in this publication.)

4. Endothall will be dropped from further consideration because of lack of interest by the manufacturer.

TERMINAL DATE OF BASE PROJECT: June 1990

DURATION OF THIS PROPOSAL: 1/1 This was to be a one-year pilot study. Additional studies by Cameron and Howard are proposed herein.

BUDGET:

		Current 1987-88	Proposed 1988-89
01	Wages	$ 2,000	0
03	Goods & Services	600	0
07	Employee Benefits	180	0
	TOTAL	$ 2,780	

PROJECT NO: 13C-0740

TITLE: Evaluation of New Herbicides for Use in Red Raspberry Production.

PERSONNEL: Stott W. Howard, Assistant Weed Scientist and Robert A. Norton, Horticulturist, Northwestern Washington Research & Extension Center, Mt. Vernon, WA

JUSTIFICATION:

Recently, several new herbicides have been introduced into the weed control market which may have potential use in red raspberry production. Because some of the herbicides presently used in red raspberry production face losing registration, it is important to evaluate these new herbicides. In addition, the efficacy of any herbicide treatment is determined by soil and environmental conditions and, since there is a broad spectrum of soil types in western Washington, it is difficult for a few herbicides to provide adequate control. It would be appropriate, therefore, to investigate the potential of new herbicides for use in raspberry production.

OBJECTIVE:

1. Evaluate the efficacy of directed applications of several new herbicides in red raspberries.

2. Determine the phytotoxicity of these new herbicides to the red raspberry plants and their effect on crop yield.

PROGRESS:

There were seven herbicides selected for evaluation on Willamette and Meeker red raspberries. Two of these, asulam (Asulox) and clopyralid (Lontrel) are being tested for use as postemergence herbicides to control existing or established weeds such as Canada thistle or dandelion. The other five herbicides, cinmethylin (Cinch), lactofen (Cobra), oxyfluorfen (Goal), prodiamine (Endurance) and pryidate (Lentigran), are being tested for use as preemergence herbicides. These herbicides are being compared to the industry standard of napropamide (Devrinol) for efficacy and phytotoxicity evaluations.

Oxyfluorfen, pronamide, cinmethylin and lactofen were applied on January 6, 1987. Evaluation of yield showed no significant differences from the untreated test plot. Following is a discussion of the potential for registration and the attributes of each compound.

Oxyfluorfen. Oxyfluorfen was applied alone and in various combinations with pronamide. The weed control in all treated plots was very good with a slight edge to those receiving the tank mixture of oxyfluorfen and pronamide. The potential for registration of oxyfluorfen appears very good at this time. Rohm and Haas has taken residue samples from the plots and has recommended that a request for an IR-4 registration program be initiated. This request was made in September.

Treatment	Rate(#ai/A)	Berry Yield (grams) Willamette	Meeker	CIR[1]
Check	--	423	468	0
oxyfluorfen	1	399	415	0
oxyfluorfen + pronamide	1+3	395	472	0
oxyfluorfen + Pronamide	2+3	407	463	0
oxyfluorfen + pronamide	4+3	416	462	0
LSD (0.05)		NS	NS	

[1] CIR = Crop Injury Rating (4-20-87) prior to first cane burning.

Lactofen. This herbicide is manufactured by PPG who has expressed interest in registration. This interest is somewhat unstable as PPG is up for sale and the purchasing company may not be interested in minor crop registrations. Weed control and crop safety were good. Lactofen will only suppress perennial weeds and is weak on weeds in the buckwheat family.

Cinmethylin. A DuPont material which is very effective in controlling most annual weeds. It works very similar to napropamide in that it kills germinating seeds and is not effective on established perennials. DuPont is currently not interested in developing cinmethylin which is unfortunate because of it's great potential for use in small fruits.

Treatment	Rate(#ai/A)	Berry Yield (grams) Willamette	Meeker	CIR[1]
Check	--	433	494	0
lactofen	0.5	384	427	0
lactofen	1.0	388	423	0
cinmethylin	0.5	361	453	0
cinmethylin	1.0	403	454	0
LSD (0.05)		NS	NS	

[1] CIR = Crop Injury Rating (4-20-87) prior to first cane burning.

Asulam, clopyralid, napropamide, and prodiamine were applied on March 16, 1987. This was the second year that these herbicides were applied to these plots. Yield data indicate no problems associated with continued use of these products. Following is a discussion of the potential for registration and the attributes of each compound.

Asulam. There has been success in controlling some perennial weeds (ie. dandelions) with asulam. Rhone-Poulenc was interested in these tests until asulam was reclassified as a potential oncogen. This has temporarily shelved any future registrations until the classification is changed.

Clopyralid. This is one of the best Canada thistle herbicides available and very effective on all weeds in the sunflower family. It currently has a registration in wheat and there are indications that Dow is interested in additional registrations. The second year application did cause transient leaf cupping in red raspberries, however, there was no long-term phytotoxicity evident.

Prodiamine. Manufactured by Sandoz, prodiamine has been very efficacious in control of annual weeds from seed. No postemergent control has been demonstrated. There has also been good crop safety with prodiamine which should encourage Sandoz to be remotely interested in a registration (it hasn't).

Treatment	Rate(ai/A)	Berry Yield (grams) Willamette	Meeker	CIR[1]
Check	--	433	494	0
napropamide	4	409	471	0
clopyralid	0.2	381	437	1
clopyralid	0.4	401	435	2
prodiamine	2	368	461	0
prodiamine	4	416	435	0
asulam	2	401	464	0
asulam	4	408	448	0
LSD 0.05		NS	NS	

[1] CIR = Crop Injury Rating

No additional funding is requested. This information has been submitted to the chemical manufacturers and where appropriate, IR-4 registration programs have been requested. Plots will be maintained for further research as requested by individual manufacturers.

TERMINATION DATE OF BASE PROPOSAL: Fall 1987

PROJECT NO.: 13C-3555-5956

TITLE: Phenotypic stability and field performance of micropropagated red raspberry cultivars

PERSONNEL: J. Scott Cameron, Assistant Horticulturist
Carol A. Hartley, Research Technologist I
Southwestern Washington Research Unit, Vancouver

JUSTIFICATION: Micropropagated plants often have altered phenotypes compared to conventionally-propagated plants. Increases in vigor and productivity and differences in morphology have been reported in micropropagated strawberries, thornless blackberries, and blueberries. While small fruit breeding programs and commercial nurseries continue to rely increasingly on in vitro propagation methods, questions concerning phenotypic stability of these plants remain unanswered. Temporary alterations in phenotype could require new selection strategies for breeders and modified cultural management for growers. To date, there have been no published reports of field performance trials of micropropagated red raspberry plants.

There are also concerns about the genetic integrity of micropropagated plants. Observations of crumbly fruit in the selection WSU 738 after micropropagation is a recent example. It is not known whether the occurrence of this disorder in WSU 738 was a result of using different source plants, differences in handling or environment, differences among clonal lines derived from micropropagation, or a post-cultural predisposition of micropropagated plants to changes in somatic cell genetics. Identifying the source(s) of such variability would be of great value to plant breeders, propagators and growers in efforts to insure the clonal integrity of plants which are used in red raspberry breeding and production.

OBJECTIVES:

1. Phenotypic stability: compare the field performance of micropropagated 'Willamette' plants to those propagated from micropropagated foundation stock after one and two years in the field.
2. Genotypic stability: to determine whether clonal lines derived from micropropagation are potential sources of variability in the field performance of micropropagated red raspberry plants.

PROGRESS: In late spring of 1987, a planting was established at Vancouver which compared micropropagated plants with planting stock derived from micropropagated foundation stock which had been in the field for either one (MP1) or two (MP2) years. Micropropagated plants were greenhouse-hardened, while the other treatments were established from dormant planting stock. Roots of all plants were dipped in a 1% solution of Ridomil prior to planting.

Establishment of the micropropagated plants was initially rather poor. Many of the plants immediately manifested symptoms of what appeared to be chemical injury; perhaps the tender root systems of these plants were sensitive to Ridomil treatment. By the end of the first season the vigor of the micropropagated plants had improved, and MP1 plants had greater number of canes and laterals per hill than did MP2 plants (Table 1). This observation is consistent with those made in other crops in which enhanced vigor from micropropagated plants dissipated within 1-2 years after culture.

PROPOSED RESEARCH:

Phenotypic stability: Yield component analysis will be performed in the 'Willamette' planting in 1988. Numbers of canes per hill, laterals per cane, fruit per lateral and mean fruit weight will be used to quantify the individual factors which determine yield in the treatments. Vegetative measurements will include cane height and diameter, leaf area and weight per leaf unit area. If there appear to be significant differences among the treatments, measurements of photosynthetic/gas exchange rates will also be made.

Genotypic stability: Early in 1988, micropropagated clonal lines will be established from one virus-free plant of WSU 738 obtained from stock with non-crumbly fruit. One single terminal, medial and basal bud from one cane will be put into culture and multiplied. In one experiment, 20 plants micropropagated from each nodal position will be compared in the field. In the second experiment, 20 clonal lines developed from one terminal bud will also be compared for variability in yield components and morphology. Five plants per clonal line will be used. Plants will be grown in single, staked hills spaced 2.75 m apart.

TERMINAL DATE OF BASE PROJECT: June 30, 1990

DURATION: Second year of a three year project.

BUDGET:

		1988
01	Temporary Employees	$2,400
03	Supplies and services	900
05	Computer services	100
07	Benefits (5% of 01)	120
	TOTAL	$3,520

Table 1. Vegetative characteristics of micropropagated 'Willamette' plants and those derived from micropropagated foundation stock after one and two years of conventional propagation.

	Cane height	No. Canes/Hill	No. laterals/hill
Micropropagated	24.8a	7.4a	0.2a
After 1 year	92.2b	7.2a	3.3c
After 2 years	99.1b	3.8b	2.0b

JSCOTT/5956/th

PROJECT NO.: 13C-3543-7956

TITLE: Management of Spider Mites on Red Raspberries

PERSONNEL: Carl H. Shanks, Jr., Entomologist,
Southwestern Washington Research Unit

Arthur Antonelli, Extension Entomologist,
Western Washington Research & Extension Center

J. Scott Cameron, Assistant Horticulturist
Southwestern Washington Research Unit

Bruce D. Congdon, Assistant Professor
Seattle Pacific University

JUSTIFICATION: The twospotted spider mite, Tetranychus urticae Koch, is a sporadic pest of red raspberries. While we have shown that severe infestations do not directly reduce either current or following years' yields, severe defoliation before September makes the canes more susceptible to freeze damage in the winter. Also, it may result in premature bud break in the fall instead of the following spring.

Currently, there are no effective miticides registered for use on raspberries. Plictran was recently removed from the market and Kelthane has been suspended, although existing stocks of the latter may be used. Vendex has a tolerance on raspberries but is not registered for use. The mite is resistant to organophosphate miticides, e.g. Metasystox-R, in most fields. There are few new miticides under development but it may be possible to get one or more older chemicals registered.

There are many predatory insects and mites that help suppress spider mite populations. In other crops, it is well known that mites in the family Phytoseiidae have an important role, but the biology and taxonomy of these predators in raspberries are poorly understood. It is well known that certain pesticides kill the predators, which can result in the development of large spider mite populations. Research is needed to determine which species of predatory mites are present, their potential role in spider mite control, and the effect that pesticides, commonly used on raspberries, have on spider mites and their predators. Also, certain cultural practices may encourage the development of predator populations or otherwise discourage the build-up of spider mite populations.

Research we did several years ago indicated that unless defoliation was very severe in August, spider mites had no effect on winter hardiness. Even though leaves had high mite populations and showed mite injury, the plant did not appear to be affected. Work is needed to determine just how much mites can reduce photosynthesis and still not affect accumulation of carbohydrates in the canes. This is critical to winter hardiness.

OBJECTIVES:

1. Determine the effect of various spray programs on red raspberries and on spider mites and their predators.
2. Determine the roles of other plants as either sources of spider mites or predators.
3. Test new miticides as they become available.
4. Determine the effect of spider mite feeding on raspberry photosynthesis and accumulation of carbohydrates in the canes.

PROGRESS:

Objective 1. Twospotted spider mite populations were monitored from May or June to mid-September in 21 raspberry fields in Clark, Pierce, Skagit, and Whatcom counties. There were spider mite populations above 25 mites per leaflet in ten of the fields. Populations above that level occurred in seven of those ten fields in July or early August, when significant plant damage is most likely to occur. There were no differences between raspberry varieties in mite populations. Even when spider mite populations rose to nearly 200 per leaflet and caused bronzing of the leaves, the leaves were still alive and probably partially functional. This indicates that many sprays of miticides could be avoided.

The predatory mite, *Phytoseiulus persimilis*, was released at the rate of one per cane in two fields in mid-July. At this rate and time, they had no effect on the spider mite population, perhaps because the latter was in such a rapid state of increase.

Morestan and Vendex, at 1 lb. ai per acre, gave excellent reduction of spider mite populations. Morestan at 0.5 lb., either alone or combined with the mite pheromone, Stirrup, was a bit less effective than at 1 lb.

Vendex was applied to blooming raspberries. It neither affected honey bee foraging behavior nor caused visible phytotoxicity. This information should complete the data requirements for registration of Vendex on raspberries.

PROPOSED RESEARCH:

Spray programs. This part of the program will be as in 1987 except on a reduced scale. Selected growers who were willing to participate in this study in 1987 will be asked to again allow us to periodically take leaf samples from their fields and to make available to us, on a confidential basis, their spray records. The leaf samples will be collected on a regular schedule during the growing season and the mites will be counted. The spray records will be studied for a possible correlation with mite population trends.

Adjacent vegetation. When weeds are present in growers' fields, they will be examined for the presence of spider mites and predators. Leaves will be collected from each plant species and the mites and any predators will be counted. Also, vegetation around the perimeters of the fields will be so examined. Mite populations on those plants will

be compared with those on the nearby raspberry plants during summer and fall, 1987 and the following spring to determine whether there is a relationship.

Permanent cover crop of grass or possibly a legume will be planted between rows of raspberries. Spider mite and predator populations on those raspberries will be compared with those in clean cultivated plots. Plots will consist of three 50-ft. rows and treatments will be replicated four times.

Phytoseiid survey. Predatory mites collected from raspberries and adjacent vegetation during established sampling routines will be positively identified. This will give access to previously published studies on the biological control potential of the species found. A basic vegetation beating technique will be modified in order to measure low early- to mid-season densities of predatory mites. As populations increase, these counts will be combined with the leaf sampling technique described above. These population monitoring data will be studied for possible correlation with spider mite population trends.

New miticides. Chemicals that effectively control mites and are, or soon will be, registered on other crops, will be tested on red raspberries. Sprays will be applied with equipment similar to that used by growers. Treatments will be replicated and randomized. Mites will be counted just prior to and at intervals after treatment. Samples of berries will be collected for residue analysis if necessary. Chemicals scheduled for testing include Morestan, Omite, and Vendex.

Effect of mites on photosynthesis and carbohydrate storage. Raspberry plants will be grown in the greenhouse and kept free of mites until use. At various times during the summer, leaves on the primocanes will be infested with twospotted spider mites. Photosynthesis and mite populations will be measured periodically thereafter. Visible leaf condition will be rated subjectively at the end of the growing season. Leaf area and weight per leaf unit area will be measured. Carbohydrate content of the canes will be determined as this is an indicator of the canes' winter hardiness.

TERMINAL DATE OF BASE PROJECT: March 31, 1991

DURATION OF THIS PROPOSAL: 3 years

BUDGET:

		1987	1988
01	Temporary Employees	$ 5,200	$6,000
03	Supplies and Services	408	440
04	Travel	432	1,000
07	Employee Benefits (Social Security, etc.; 5% of 01)	260	300
	TOTAL	$ 6,300	$7,740

PROJS/mitesrr

PROJECT NO.: 13C-3543-6956

TITLE: Control of Insect Contaminants of Red Raspberries by Irradiation.

PERSONNEL: Carl H. Shanks, Jr. Entomologist
Southwestern Washington Research Unit

JUSTIFICATION:

There is increasing interest in shipment of fresh red raspberries from the Pacific Northwest. Currently these are going to U.S. markets but export to foreign markets is a possibility. Many species of insects and mites reside on raspberry plants and any of them are potential contaminants of the fresh berries. It is likely that many countries or states will require the berries to be free of live insects and mites in order to prevent introduction of new pests into those areas.

One promising method of treating food to increase its shelf-life and quality is irradiation. The U. S. Department of Energy built a full-scale demonstration irradiator, which was operated by Battelle Northwest, near the Tri-Cities. This irradiator was used in 1987 to determine its potential for killing insect contaminants of fresh raspberries.

OBJECTIVE:

To determine whether irradiation can be used to kill insect contaminants of fresh raspberries.

PROGRESS (Final report):

Insects and other arthropods were collected from raspberry plants by shaking the foliage over a cloth on the ground. Each type was divided into five groups and placed in plastic containers with food. They were taken to Battelle Northwest at Richland, Washington. There each arthropod type was exposed to 0, 20, 40, 80, or 160 krad of gamma radiation. They were observed periodically for mortality. Due to results with the two highest rates, only the 0, 80, and 160 krad rates were evaluated.

The following arthropods were tested: adult black vine weevil, raspberry aphid, orange tortrix larvae, stink bugs, rose leaf hopper, European earwig, ladybird beetles, lygus bugs, a hemerobiid bug, spiders, and daddylonglegs. The highest rate (160 krad) killed very few of any of the arthropods within 5 days of treatment and only moderate numbers during the next 4 days. The 80-krad rate killed almost none during the 9-day observation period.

The black vine weevils were kept for observation for a month. Twelve days after treatment, those receiving 160 krad were all dead but most of those receiving lower dosages were alive. Thirty days after treatment, nearly all weevils that had been treated with 20-160 krad were dead but only 2 of 15 untreated weevils were dead.

Although radiation may eventually kill some arthropods in fresh raspberries, it appears to be unreliable for making fresh raspberries free of these contaminants. First, not all of them are killed. Second, they are killed too slowly. Fresh raspberries would be in grocery stores within a few days, perhaps 1-3, and arthropod contaminants must be killed before that.

DURATION OF PROJECT:
1 year for pilot study. No more funds are requested.

TERMINAL DATE OF BASE PROJECT: March 31, 1991

PROJS/insectrr/ts

PROJECT NO: AES #688

TITLE: Relationship of blind bud to potential yield at variable cane populations and concentrations of KNO_3 spray solution.

PERSONNEL: Joseph DeFrancesco, Research Assistant and
Lloyd W. Martin, Superintendent and Professor of Horticulture, North Willamette Experiment Station

JUSTIFICATION:

The failure of red raspberry plants to produce their theoretical potential yield is well recognized. Potential yield, which is calculated on the basis of yield components (plant population, buds per cane, fruiting laterals per bud, fruits per lateral, and size of fruit) is usually about 200% of actual yield. The question remains why plants do not produce to their theoretical potential and whether, through cultural or special physiological means, yield components may be altered and actual yield increased.

We believe blind bud (failure of bud to grow and produce a fruiting lateral) is a major problem. It is not uncommon for 20 to 40% of 'Meeker' buds to fail to grow. Chemicals have been used to break dormancy of raspberries in Israel and we believe that they should be evaluated in relation to blind bud in the Pacific Northwest.

OBJECTIVES:

(1) To evaluate how competition among floricanes affects fruiting components.

(2) To evaluate various concentrations of potassium nitrate (KNO_3) spray solutions as a means of reducing incidence of blind bud.

(3) To measure effect of various pruning treatments on the next season's primocane growth and subsequent year's fruiting components.

PROGRESS:

Two separate research experiments were established in a commercial field of 'Meeker' red raspberries near St. Paul, Oregon. One consisted of different pruning treatments: individual plants of red raspberries were cut back to either 1, 2, 3, 4, 5, 6, 7 or 8 canes per hill, replicated six times. The treatments in the other experiment, located in the same field, consisted of four concentrations of KNO_3 (0%, 5%, 10%, 20%) solution sprays, replicated six times.

Data collected, to date, consists of percentage of blind buds, percentage of fruiting laterals of the buds that did develop, average number of fruits per lateral and average berry size.

Preliminary analysis of the data reveals that there was no statistically significant difference between treatments for either the pruning experiment or the KNO_3 experiment. One explanation for this may be that the treatments were applied rather late (early March 1987) and some buds were showing white tips and at the verge of breaking at that time. In 1988 we will apply treatments while plants are still completely dormant.

Since pruning affects vegetative regrowth, these plants will not be comparable next year. The same basic procedures and evaluations will be carried out on a new set of uniformly developed plants. A planting of ORUS-1836 red raspberries has been established at the North Willamette Experiment Station for this purpose.

Measurements of primocane growth on the original set of plants that received the pruning treatments will be taken in Fall of 1987.

Table 1. Red Raspberry Blind Bud Experiment - Pruning Treatment

	Characteristics[a]			
Treatment	Blind Buds[b] (%)	Fruiting Laterals (%)	No. of Berries per Lateral	Berry Size (g)
Remaining Canes				
1	25	97	11.4	2.62
2	10	97	14.6	2.58
3	28	92	12.7	2.54
4	23	88	11.3	2.68
5	25	92	14.2	3.07
6	16	87	11.3	2.85
7	17	90	12.9	2.63
8	25	89	13.4	3.02

[a]Average of six replications
[b]Blind bud is one that failed to develop

Table 2. Red Raspberry Blind Bud Experiment - KNO_3 Treatment

Treatment KNO_3 Solution (%)	Characteristics[a] Blind Buds[b] (%)	Fruiting Laterals (%)	No. of Berries per Lateral	Berry Size (g)
0	38	87	13	3.02
5	22	85	12	2.75
10	30	84	11	3.00
20	27	79	11	2.75

[a]Average of six replications
[b]Blind bud is one that failed to develop

PROPOSED RESEARCH:

This will be a continuation of the work begun in 1987. Pruning treatments (1 to 8 canes remaining) will be applied to ORUS-1836 red raspberries at the North Willamette Experiment Station. KNO_3 treatments (0%, 5%, 10%, 20%) will be applied on two different dates to plants in a commercial field of 'Meeker' red raspberries. Data collected will include time of bud break, percentage of blind buds, percentage of fruiting laterals, average number of fruits per lateral and average berry size.

Number and diameter of primocane regrowth of plants receiving the pruning treatments will be conducted in the Fall of 1988.

TERMINAL DATE: 1990

DURATION: Three Years.

BUDGET:

	Current 1987-88	Proposed 1988-89
Hourly labor and 5% OPE	$2,000	$2,000
Services and supplies	500	500
Total	$2,500	$2,500

APPROVAL:

Lloyd W. Martin (pro) — 10-14-87
Lloyd W. Martin, Superintendent (date)
North Willamette Experiment Station

for Leng Jong Koong — 10/15/87
Thayne Dutson, Director (date)
Agricultural Experiment Station

Robert A. Frakes, acting for — 10/15/87
George H. Keller, Vice President (date)
for Research, Graduate Studies and
International Programs

for Bruce Jack — 10/15/87
Richard C. Greenwood, Director (date)
OSU Business Affairs

Title: Suppression of Primocanes in Caneberries, 1988-89.

Project Leader and Department:
Drs. Bill Braunworth, and Garvin Crabtree
Department of Horticulture
Oregon State University
Corvallis, OR 97331

Project Number: Agricultural Experiment Station; 30-262-xxxx

Status: For work in 1988-89 which is continuing from work not funded in 1987-88.

Objectives: 1) Conduct evaluations of chemicals which could be used to suppress the growth of primocanes in blackberries and raspberries. 2) Seek the registration of any chemicals or practices which are successful. This would include residue analysis where appropriate. 3) Communicate the results of useful practices to the growers of caneberries.

Justification: Dinoseb has been taken off the market and the prospects for keeping dinoseb available to growers in the long term are doubtful. We have initiated a series of test plots which are coordinated with research workers in Washington and British Columbia. These plots are now in progress. In Oregon our test plots are on red raspberries and evergreen blackberries located at Sandy Farms, Sandy, Oregon.

Research Program:

A. Experimental Design:

Plot length 15-24 feet; width 3 feet; 3-4 replications. There will be one check plot with the standard application of dinoseb and a check plot where no chemical suppression is applied. A randomized complete block experimental design will be used. Three experiments will be conducted on two crops, 2 tests on evergreen blackberries (one bearing and one nonbearing) and one test on red raspberries. If funds from all sources are not sufficient some of the work will be cut. See location section for further information.

B. Treatments:

1. Herbicides to be evaluated:
Cobra (lactofen); emulsifiable concentrate (2 lbs ai/gal).
Goal (oxyfluorfen); emulsifiable concentrate (1.6 lbs ai/gal).
Possibly others

2. Dosage: 0.25, 0.50, 1.00, and 2.00 lb ai/a are the rates most likely to be evaluated for Goal and Cobra. Dinoseb at 2.5 lb ai/gal will be included as one of the treatments.

3. Volume: 30 gal/a; water. Higher volumes would be worth looking at, but last year adequate suppression was achieved with 30

gal/a. The industry standard for dinoseb of 100 gal/a of water will be maintained only on the dinoseb treatment. 1 gal/a of Volk's oil will be added to Cobra treatments and 0.25% on a volume basis of Volk's oil should be added to the Goal treatments.

4. Timing of Applications: Apply as repeated applications to the same plots through the season to suppress growth of primocanes and lower lateral fruiting canes. Applications should be before the canes are 6 inches in length and still succulent.

5. Apply with ground sprayer, directing the spray to the base and up to 18-24 inches on the fruiting canes. Cone spray nozzels will be used which will form a band covering the areas between the canes as well. One pass on each side of the berry row will provide proper treatment.

6. Locations: In 1987 plots were established on red raspberry and evergreen blackberry in Sandy, Oregon. The blackberry plot may be continued with the same plots in 1988, but 1988 will not be the bearing year since this is an alternate year production system (test plot 1). It would be useful to establish an additional blackberry plot in a field where fruit will be harvested in 1988 (test plot 2). The red raspberry plot should be re-established in Sandy or some other location (test plot 3). The red raspberries are not grown on an alternate year system, thus fruit will be produced from the plots in 1988.

C. Recording and Reporting Results:

1. Efficacy

a. Effectiveness: Suppression of primocanes and the lower fruiting laterals will be rated visually on a scale of 0 to 10. 10 will indicate complete suppression while 0 will indicate no suppression. This visual rating will integrate the degree of burn back of individual canes and the number of canes and laterals escaping control. Ratings will begin 7 days after the first application and then approximately weekly through the season. Evaluations will be sure to include a rating 7 days after each treatment date.

b. Yield: From studies in 1987 there is no evidence of phytotoxicity to the the current year's fruiting canes. Yield measurements in this case would not be necessary, however, in subsequent years after repeated use, yields should be obtained to be sure there is no long-term suppression of yield.

c. Phytotoxicity: This scale will be the same as that described above for effectiveness.

2. Residue Samples

a. Sampling Schedule: Berry samples will be collected at the time of commercial harvest. In 1987 this was 64 days after the

second application of suppression treatments in red raspberries. The fourth (last) application of the season was 33 days before harvest for evergreen blackberries in 1987. The companies, PPG and Rohm and Haas, may be willing to do the lab analysis. The status of this possibility is uncertain because marketing decisions have not been made yet. These costs can be worked out at a latter date.

Proposed Budget Statement:

a.	Field:	
(1)	labor	000.00
(2)	supplies	300.00
(3)	travel	450.00
	Total	$ 750.00

Note: Attached is a report of the results of the 1987 tests on red raspberries and evergreen blackberries.

propscne.89w

Alternatives to Dinoseb for Caneberries

William S. Braunworth, Jr.

Department of Horticulture, Oregon State University.

The use of dinoseb is critical for the suppression of primocanes in caneberries since there are no other registered alternatives. Various herbicides were evaluated for primocane suppression in red raspberries (Willamette) and evergreen blackberries in Sandy, Oregon.

The experimental treatments and application rates for red raspberries are listed in Table 1. Applications were made on 31 March and 15 April, while harvest was 6 June, 1987. The paraquat (Gramoxone) plus Goal treatment was an exception to this, with only one application on 31 March. Regrowth on 15 April did not warrant a second application of the paraquat plus Goal treatment. Ratings were based on a visual assessment of the degree of control of the primocanes and lateral buds. These ratings were made 5 times during the season (Table 1).

Of the 19 treatments studied only the standard dinoseb, and paraquat plus Goal provided adequate suppression of the primocanes. The mechanical treatment also had excellent suppression ratings. However, this treatment was done by hand and not reasonable on a commercial basis.

Based on the results from the red raspberry test a revised set of treatments was selected for the evergreen blackberries (Table 2). Application dates for all treatments were 24 April, 13 May, 11 June, 1 July, 1987. Cane suppression ratings were made 10 times from 30 April to 24 July, 1987 (Table 2).

Two herbicides, Goal and Cobra both at rates of .5-1.0 lb ai/a, in addition to dinoseb showed commercially acceptable levels of cane control. The higher 2 lb ai/a rate of Goal did not provide significantly greater control than the 1.0 lb rate. The paraquat plus Goal treatment was also commercially acceptable but the data on Goal applied alone indicates that paraquat is not necessary.

No damage to the fruiting canes or the fruit was observed in the raspberries or the blackberries. It is important to study these herbicides for several seasons to be certain no crop injury occurs with repeated applications.

Table 1. Suppression of primocanes of Willamette red raspberries, 1987.

Treatment No.	Name	Application rate (lb ai or gal/a)	Rating (0-10) of Cane Suppression 4/07/87	4/15/87	4/21/87	4/24/87	4/30/87	Canes/plant 4/07/87
01	PARAQUAT	0.5	2.2	1.0	.7	0	1.0	15.0
	X-77	.25%						
02	PARAQUAT	1.00	3.5	2.4	2.0	1.3	2.3	15.3
	X-77	.25%						
03	DIQUAT	0.50	4.8	3.5	3.7	3.3	3.3	14.7
	X-77	.25%						
04	DIQUAT	1.00	5.3	4.2	5.0	3.7	4.3	16.7
	X-77	.25%						
05	PARAQUAT	0.25	5.2	3.5	3.7	2.3	3.0	15.0
	DIQUAT	0.50						
	X-77	.25%						
06	PARAQUAT	0.50	3.4	3.2	4.0	1.7	3.0	16.0
	DIQUAT	1.00						
	X-77	.25%						
07	N-TAC	*20.00	6.2	5.6	6.2	4.7	5.3	15.0
	#OIL	* 1.00						
08	N-TAC	*20.00	5.2	4.6	6.7	5.3	6.0	16.0
	X-77	0.25						
09	ENDOTHALL	0.50	5.0	4.5	5.8	5.5	6.3	15.0
	OIL	* 1.00						
10	ENDOTHALL	1.00	5.6	3.8	5.0	4.7	6.7	16.0
	OIL	* 1.00						
11	ENDOTHALL	2.00	6.2	6.3	7.8	7.7	6.7	17.0
	OIL	* 1.00						
12	PARAQUAT	0.40	8.8	9.6	8.3	8.3	7.3	15.3
	GOAL	0.50						
	X-77	.25%						
13	DINOSEB	2.50	8.0	7.9	9.2	9.7	7.7	16.3
	OIL	* 1.00						
14**	PHOSACID	15.00	6.0	3.6	5.0	2.3	5.0	16.0
	OIL	* 1.00						
15	PHOSACID	30.00	6.1	4.9	6.0	4.3	5.7	14.3
	OIL	* 1.00						
16	DIESEL	100.00	6.1	6.1	5.8	5.0	7.0	14.7
	X-77	.25%						
17	FLAME (butane torch)		6.6	3.6	4.2	1.0	2.0	14.7
18	MECHANICAL (by hand)		9.8	9.4	10.0	9.5	7.3	15.0
19	CONTROL		0	.2	0	0	0	16.7
	LSD(0.05) =		2.0	2.2	1.9	2.5	1.7	1.8
	STANDARD DEVIATION =		1.2	1.3	1.1	1.5	1.0	1.1
	COEFF. OF VARIABILITY =		21.5	28.1	21.8	35.5	21.3	7.1

* = Rate is in gal/a; Spray volume was 60 gal/a and 100 gal/a for first and second applications respectively. All other treatments were 30 gal/a.
** = PHOSACID is phosphoric acid; # = The oil used was Volk's Supreme.

Table 2. Suppression of primocanes of thornless evergreen blackberries, 1987.

Treatment No.	Name	Application rate (lb ai or gal/a)	Rating of (0-10) for cane suppression 4/30/87	5/07/87	5/13/87	5/21/87	6/02/87	6/11/87	6/22/87	6/29/87	7/08/87	7/24/87
01	DIQUAT	2.00	4.0	4.0	4.7	6.0	4.7	4.0	6.8	6.0	6.7	5.3
	X-77	.25%										
02	N-TAC	**20.00	4.0	4.3	4.0	5.8	3.7	3.0	6.7	5.2	6.7	5.5
	#OIL	* 1.00										
03	ENDOTHAL	2.00	1.3	.7	1.7	3.0	2.0	3.0	3.3	2.7	3.0	3.2
	OIL	* 1.00										
04	ENDOTHAL	3.00	3.3	2.7	3.0	4.3	1.3	2.0	4.5	4.0	4.7	4.2
	OIL	* 1.00										
05	PARAQUAT	0.40	6.7	5.8	5.0	7.4	6.8	6.0	7.2	6.3	7.5	5.7
	GOAL	0.50										
	X-77	.25%										
06	GOAL	0.50	6.0	7.0	6.0	8.4	7.3	7.0	8.2	7.0	7.0	6.3
	X-77	0.25%										
07	GOAL	1.00	6.3	8.3	6.3	8.8	7.7	7.0	8.8	7.8	8.2	6.7
	X-77	0.25%										
08	GOAL	2.00	6.3	8.7	6.0	9.0	8.3	8.0	9.3	8.2	8.7	8.0
	X-77	0.25%										
09	COBRA	0.50	7.7	7.7	6.3	9.1	8.0	8.0	9.0	7.0	8.7	7.8
	OIL	* 1.00										
10	COBRA	1.00	7.2	7.7	5.7	9.2	8.2	8.0	9.3	7.8	9.0	8.2
	OIL	* 1.00										
11	NH4NO3	**30.00	3.0	2.0	3.0	2.8	3.3	3.0	4.5	2.2	3.7	4.3
	KCL	30.00										
	SOLUBOR	5.00										
	OIL	* 1.00										
12	DINOSEB**	2.50	6.7	7.0	5.0	7.9	6.7	7.0	9.2	7.8	8.3	6.0
	OIL	* 1.00										
13	CONTROL		0	0	0	0	0	0	0	0	0	0
	LSD (0.05) =		2.0	2.2	1.8	1.9	1.7	NA	1.8	1.7	1.4	1.5
	STANDARD DIVATION =		1.2	1.3	1.1	1.1	1.0	NA	1.1	1.0	.8	.9
	COEFF. OF VARIABILITY =		24.5	26.4	24.7	18.2	19.3	NA	15.8	18.3	12.9	16.7

* = Rate is in gal/a.
** = Total spray volume was 100 gal/a; all other treatments were 30 gal/a.
# = The oil used was Volk's Supreme.
Scale is 0 = no cane suppression; 10 = complete suppression.

PROJECT NO.: USDA ARS Trust Fund 58-9AHZ-3-705.

TITLE: Development of virus-tested red raspberry cultivars and of virus testing methods for them.

PERSONNEL: R. H. Converse, Research Plant Pathologist, USDA-ARS; and Research Assistant, Oregon State University.

JUSTIFICATION: Virus-tested raspberry clones are essential for a raspberry nursery industry based upon certified stock and for healthy commercial raspberry fruit plantings. USDA-ARS maintains a group of virus-indexed clones of most of the currently popular commercial red raspberry cultivars of the Pacific Northwest. These clones are periodically tested for viruses and are vegetatively propagated in screenhouses in small quantities for research workers and for State Departments of Agriculture. Most of these clones come from heat-treated, shoot-apex-propagated sources in this laboratory. New selections from publically supported raspberry breeding programs in the Pacific Northwest, as well as superior clones of standard cultivars are passed through this virus detection, heat therapy, tissue culture and increase program by USDA-ARS as they become available.

Detection of the viruses in red raspberry is also an area of ongoing research and improvement in this laboratory. Rapid, accurate, comprehensive virus detection methods are essential for the production of virus-tested raspberry clones. In addition to using present standard graft indexing and serological methods for virus detection of viruses already known to occur in the Pacific Northwest, this USDA-ARS lab is exploring new techniques for detection of known viruses and ways to identify viruses new to the region.

OBJECTIVES:

a) Develop virus-tested clones of PNW cultivars and advanced selections through extensive indexing, heat therapy and shoot apex culture, where such clones are needed but not yet available.

b) Evaluate virus content and conduct heat therapy and shoot apex culture of possibly superior clones of major PNW red raspberry cultivars, as they are recognized and made available for testing.

c) Improve raspberry virus detection methods with respect to accuracy, sensitivity, rapidity, and breadth.

d) Index, maintain, and increase desirable virus-tested raspberry clones for distribution to research workers and to State Departments of Agriculture.

PROGRESS:

a) The following heat-treated, meristem-propagated red raspberry cultivars were increased and distributed to requesting research workers and State Departments of Agriculture in 1987: August Red-85HT, Amity-85, Amity-85M, Canby-81M, Chilcotin-AC, Chilcotin-86M, Heritage-79, Heritage-86M, Meeker-81M, Skeena-79, Willamette-80M. The following OR-US Rubus selections were heat-treated, meristem-propagated, increased and released to requesting scientists and cooperating nurseries in 1987: ORUS 1658 ORUSM 78, ORUS 1835 ORUSM 37, ORUS 1836 ORUSM 162, ORUS 2033 ORUSM 250, ORUS 2078, ORUS 520-48 ORUSM 176, ORUS 716-4, ORUS 932-2.

b) Explants (identified below by ORUSM numbers or USDA-ARS selection numbers) that were developed in 1987 by high carbon dioxide therapy and 100 micron shoot-apex tissue culture included: ORUS 744-2, ORUS 1734, ORUS 680-1. These plants are currently being increased in the screenhouse for 1988 evaluation, further testing, and distribution as requested.

c) The following red raspberry cultivars and USDA ARS-OR selections have been placed in heat therapy or are being readied for heat therapy: superior Willamette clones to be identified by WSU Puyallup personnel from the program left by Dr. T. Sjulin in spring 1987, and ORUS 959R-1, ORUS 613R-8, ORUS 613R-9, 932-2, and Fallgold.

d) An evaluation of the viruses present in red raspberry cultivars being grown in commercial fields in the Pacific Northwest (PNW) was begun. Sap and leaf graft indexing of 20 clones from Washington was done and virus evaluation is in progress. Additional Washington collections are to be made in fall 1987 and the entire PNW collection will be evaluated serologically for black raspberry necrosis virus as well as by bioassays before the survey is completed.

PROPOSED RESEARCH:

a) Heat-treat in a high carbon dioxide atmosphere, shoot-apex, virus index, and screenhouse-propagate cultivars and selections

identified by USDA-ARS and WSU personnel including possibly horticulturally superior Willamette clones originating from the program of Dr. T. Sjulin at WSU and now being held in Converse's screenhouse.

b) Virus-index and increase previously heat-treated, meristemmed PNW cultivars and selections in screenhouse for distribution to research workers and to industry through requesting State Departments of Agriculture.

c) Complete PNW red raspberry virus survey.

d) Plans and materials have been assembled to prepare antisera designed to identify latent infections of downy mildew disease in cultivated Rubus, caused by Peronospora sparsa. This fungus lives within the crown tissues of infected plants and has been found in PNW red raspberry nursery stock. Development of a rapid, sensitive serological test for this fungus will make possible the production of cleaner nursery stocks.

BASE PROJECT TERMINATION: 24/4/89. Timing for this proposal is 1/3.

BUDGET:

Research Assistant, (0.35 FTE)	$6,200
Employee benefits (OPE at 32%)	2,000
Supplies	800
Mandatory OSU 10% overhead on $9,000	900
TOTAL	$9,900

We suggest that this budget be made available to the U.S. Department of Agriculture, Agricultural Research Service for Trust Fund No. 58-9AHZ-3-705. As noted above, there is now a mandatory 10% overhead charge by Oregon State University on all funds paid by USDA ARS to OSU for work of the kind specified in this proposal. The continuing ability of this research project to supply virus-tested raspberry stock to industry in the Pacific Northwest rests on the ability of the Washington Raspberry Commission and the Oregon Caneberry Commission to support the technical assistance needed to produce these plants.

PROJECT NO.: New

TITLE: Advanced Testing of Washington State University Raspberry Selections

PERSONNEL: Patrick P. Moore, Assistant Horticulturist, WWREC, Puyallup
Robert A. Norton, Horticulturist, NWREC, Mt. Vernon
J. Scott Cameron, Assistant Horticulturist, SWRU, Vancouver

JUSTIFICATION:

Developing a new raspberry cultivar is a long-term process. Promising selections must be tested against standard cultivars in a replicated trial. If the selection performs well in this test, it then needs to be tested against standard cultivars in several locations throughout the region in which it will be grown. Accurate records of yield, fruit quality, susceptibility to pests at these locations is necessary in deciding to release or discard a promising selection. Many characters under genetic control are affected strongly by environment. Estimates of the effect of location on these characters will provide useful information which can improve the efficiency of a breeding program.

OBJECTIVES:

1. To establish and maintain replicated plantings at WWREC in Puyallup, NWREU in Mt. Vernon and SWRU in Vancouver of advanced selections from the Washington State University and other regional raspberry breeding programs.

2. To measure yield, fruit quality, and susceptibility to pests in these selections as part of the ongoing cultivar development process.

3. To measure genotype by environment interactions in these selections for traits under improvement.

PROGRESS:

Selection WSU 892 (Cherokee X Skeena) had a marketable yield comparable to Meeker, Comox, and Chilcotin in 1987 at Puyallup. It appears to have good cold resistance, ease of picking, and growth habit. It has promise for machine harvest and for processing.

PROPOSED RESEARCH:

New plantings will be established at Vancouver, Puyallup, and Mt. Vernon. WSU 892 will be planted along with the standard cultivars

Meeker, Chilcotin, Chilliwack, and Comox. Chilliwack and Comox are new Agriculture Canada cultivars and their performance at several locations in western Washington needs to be evaluated. Additional advanced selections from Agriculture Canada and Oregon State University will be included if plants are available.

The plantings will be established in 1988 and harvest data will begin to be collected in 1990.

TERMINAL DATE OF BASE PROJECT:

Experiment station project currently being developed.

DURATION OF PROPOSAL: First year of a three-year proposal.

BUDGET:

		1988-89
03	Supplies and Services	$600
	Total	$600

The budget would be divided equally among the project leaders at each location ($200 each).

PROJECT NO.: New

TITLE: Equipment for small fruit breeding

PERSONNEL: Patrick P. Moore, Assistant Horticulturist; JoAnn Robbins, Agricultural Research Technologist III; Laura Quirie, Plant Technician II; Ron Schwinkendorf, Plant Technician II, WWREC, Puyallup.

JUSTIFICATION:

The funding of the small fruit breeding program at Washington State University has been primarily for labor for harvest, data collection and for supplies directly required for the establishment of studies. Monies have not been available to upgrade and maintain equipment and buildings in order to stay current with advancing technological development. The program has expanded and there is a need for additional equipment and capitol expenditures to sustain expansion and to allow efficient operation.

1. Computer

   Data collection and analysis is essential to a plant breeding program. The greatest equipment need of the program is a computer. The machine should have large memory capacity (640K) and a 20 megabyte hard drive. This would allow statistical analysis of data at Puyallup permitting more extensive analysis of the data.

   A second smaller computer, compatible with the above computer, is needed for routine data entry and word processing. Printers, monitors, and modems will also be needed. The computers will allow better record keeping for selections and studies.

2. Electronic data recording devices

   The program currently uses an Omnidata Polycorder for collecting field harvest data. The data is then electronically transmitted to the computer for analysis. A portable electronic balance (K-Tron, KS-1) which is capable of interfacing with the Polycorder is used for determining the weight of berries, rot, and total yield. The weight can be electronically transferred to the Polycorders rather than entered by hand. This increases the speed of data collection and analysis, and greatly increases the accuracy.

   A second Polycorder and a second portable electronic balance will allow the simultaneous collection of harvest data or collection of data from studies in two locations.

3. Colorimeter

A colorimeter is needed to objectively determine and quantify fruit color. The Gardner XL-20 colorimeter is capable of measuring external color of raspberries, and internal and external color of strawberries. The instrument will objectively measure color differences between genotypes, different stages of maturity, and changes in color during storage. Our current method of matching berry color to Munsell color chips is subjective and varies greatly among observers and over time for the same observer.

4. Laminar Flow Transfer Hood

A tabletop laminar flow transfer hood will allow development of and provide an area for tissue culture. Micropropagation of selections will decrease the amount of time required to produce a sufficient number of plants for testing. The hood will also be used in future studies on the effects of tissue culture treatments on subsequent plant performance.

5. Renovation of Screenhouse Facilities

Our screenhouse facilities are an essential part of both the strawberry and raspberry breeding programs. These facilities are in need of major renovation, and need to be upgraded for overwintering plant material. Fiberglass glazing needs to be replaced within 5 years, and repair of structural wood is needed. A better heating system is needed in selected houses.

Equipment in this proposal will be used for both strawberry and raspberry improvement. Therefore, this request has been submitted to each Commission with the equipment to be funded jointly. The amounts contributed will be determined by each Commission. If only a portion of the equipment request can be funded, the items are listed in order of priority to the breeding program.

TERMINAL DATE OF BASE PROJECT:

Strawberry: June 30, 1990; Raspberry: Experiment Station project currently being developed.

BUDGET:

Priority		
1	Computer	$ 6,500
2	Recording devices	5,000
3	Colorimeter	9,700
4	Transfer hood	2,400
5	Screenhouse	20,000
	Total	$43,600

PROJECT NO.: New

TITLE: Advanced Testing of New Compounds for Caneburning of Red Raspberry

PERSONNEL: J. Scott Cameron, Assistant Horticulturist
Southwestern Washington Research Unit, Vancouver

Stott W. Howard, Assistant Weed Scientist,
Northwestern Washington Research and Extension Center,
Mt. Vernon

JUSTIFICATION:

The loss of dinoseb for caneburning in red raspberries has left the industry without an effective tool for primocane suppression. Research programs in Washington (SEE report by Norton and Howard), Oregon, and California have sought alternatives to dinoseb with a goal of having an effective replacement registered for use in the near future. One class of compounds, the diphenyl ethers, has shown considerable promise in recent field trials.

The efficacy of a compound in suppressing primocane growth is not the only factor which must be considered in selecting a caneburning method for commercial use. The effects of such compounds on productivity and long term growth and development must also be tested. This is of particular importance when dealing with chemicals such as diphenyl ethers, contact herbicides which are strong mitotic poisons. The purpose of this project is to thoroughly evaluate the influence of these potential caneburning compounds on the productivity, growth, and development of red raspberry.

OBJECTIVES:

1. Evaluate cane suppression characteristics and yield component relationships associated with the use of new caneburning compounds.
2. Study long-term effects of using these compounds on productivity, growth, and development of established red raspberry plantings.

PROPOSED RESEARCH:

Three new caneburning compounds will be tested at Vancouver and Mt. Vernon. The three compounds, oxyfluorfen, acifluorfen, and lactofen (tradenames respectively, Goal, Tackle/Blazer, and Cobra) will be applied once on newly emerging primocanes at five different rates: 0.1, .2, .4, .8, and 1.6 lbs/A. A fourth treatment group will receive 2-3 applications of dinoseb, while a fifth group will remain untreated. Studies will be conducted in established plantings of 'Meeker' with four replications per treatment. Plots will consist of three adjacent hills within a row. Fruit will be harvested by hand at regular intervals. Yield components to be studied will include numbers of canes per hill, fruitful nodes per cane, fruit per node and individual fruit weight. Measurements of vegetative growth and subsequent primocane regrowth will

be recorded. Measurements of photosynthesis and gas exchange will also be made in order to determine possible physiological influences of caneburning with these compounds. In the following seasons, yield component analyses will be performed in order to monitor the productivity, growth and development of the treatment groups. Information obtained from this study will be used for possible IR-4 registration.

TERMINAL DATE OF BASE PROJECT: 10A-3555-0783, June 30, 1990
10A-3419-0740, June 30, 1989

DURATION OF THIS PROPOSAL: Three years.

BUDGET FOR 1988:

		Vancouver	Mt. Vernon
01	Temporary employees	$ 2800	$ 2800
03	Supplies and services	212	212
04	Travel	500	500
05	Computer services	50	50
07	Employee benefits (5% of 01)	140	140
	SUBTOTAL EACH SITE	$ 3,702	$ 3,702
	TOTAL	$7,404	

JSC/caneb/th

PROJECT NO.: New

TITLE: Leaf/fruit ratio and yield potential in red raspberry

PERSONNEL: J. Scott Cameron, Assistant Horticulturist
Carol A. Hartley, Research Technologist I
Southwestern Washington Research Unit

JUSTIFICATION: In tree fruits such as apple and cherry, it is known approximately how many leaves are required to produce a fruit. This information has been extremely useful in developing a scientific approach to canopy design and cultural management. A major goal of this area of research is to understand the mechanics of light penetration so as to maximize photosynthetic potential of the leaves. Many plant species produce more leaf surface area than is required to make fruit. Excess products from photosynthesis not exported into fruit can accumulate as starch in chloroplasts and reduce the photosynthetic efficiency of the leaf. Conversely, when insufficient leaf area is present to supply photoassimilates, fruit will not develop normally or will be smaller in size. There are no published reports concerning leaf area/assimilate demand relationships in red raspberry; this type of information would be very useful in determining the yield potential of this crop while implementing new strategies to increase the efficiency of its culture.

PROPOSED RESEARCH: Two experiments will be performed in which the influence of various leaf to fruit ratios on photosynthetic rate and fruit development will be observed. In the first experiment, measurements of photosynthesis will be made on leaves at nodes which appear to represent a wide range of leaf areas and fruit loads. Measurements will be made at harvest in established plantings of a number of cultivars. Leaves and fruit will be harvested in order to quantify leaf area and fruit weight. Multiple regression techniques will be used in order to examine the relationship between leaf area and assimilate demand.

In a second experiment with 'Amity', leaf to fruit ratios will be artificially manipulated several days prior to harvest by removing 1/3, 2/3, or all of the leaf area at each of the terminal 15 nodes. All fruit and leaves below that point will be removed. Fruiting and defruited canes with intact leaf area will be included as controls. On the following three days, measurements of photosynthesis will be made at each node in each treatment. For the treatment in which all cane leaves were removed, photosynthetic measurements will be made on leaves of fruiting laterals. On the third day, fruit and leaves will be harvested and measurements of leaf area, fruit weight and soluble solids will be made. Cane and leaf carbohydrates will also be analyzed. The relationships among carbon assimilation rate, fruit weight and leaf area will be analyzed using multiple regression techniques.

TERMINAL DATE OF BASE PROJECT: June 30, 1990

DURATION OF PROPOSAL: One year with the possibility of extension based upon results of these experiments.

BUDGET:

		1988
01	Temporary employees	$1,500
03	Supplies and services	200
07	Benefits (5% of 01)	75
	TOTAL	$1,775

JSCOTT/leaf/ratio/th

PROJECT NO.: ~~NEW~~ Continuing

TITLE: Development of a simple, rapid and sensitive test for raspberry leaf spot virus.

PERSONNEL: Robert R. Martin, Plant Virologist, Agriculture Canada Research Station, 6660 NW Marine Dr. Vancouver, B.C. V6T 1X2

JUSTIFICATION:

In 1986 we carried out a survey of raspberry viruses in Washington and British Columbia. Of 440 samples tested we found 65 infected with a virus we are calling raspberry leaf spot virus (RLSV). This was by far the most common virus detected in the survey. In this survey RLSV was detected by extracting and analysing double stranded ribose nucleic acid (dsRNA) present in raspberry. Since healthy raspberry only contains a single high molecular weight dsRNA it is possible to determine the presence of viral specific dsRNAs in raspberry. This is a very laborious and expensive procedure for virus detection, but at the present it is the best we have for this virus. The dsRNA procedure is not readily adapted to use by certification agencies, at best it could be used to test nuclear stocks. There is a need to have a test capable of handling large numbers of samples so that material at the foundation and certified levels can be tested as well. If these later stages of plant production are tested then weak links in the production of virus free material can be identified and corrected.

OBJECTIVE:

To develop an assay system for raspberry leaf spot virus which can be used for large scale testing.

PROGRESS:

During the summer of 1987 I had a summer student funded by the Washington Red Raspberry Commission and Agriculture Canada provided supplies for the purification of dsRNA from RLSV infected raspberry. We are now using this dsRNA in attempts to make complementary cloned DNA to RLSV. Our initial attempts have failed but we have enough purified dsRNA to test more cloning strategies. If these fail we will purify more dsRNA from plant material stockpiled in the freezer and continue attempts at cloning from the dsRNA. We recently had a visitor from Brisbane, Australia who has had limited success in cloning from dsRNA and we will be using his protocol in our next cloning attempts. Also a recent paper described in vitro translation of gene products from

dsRNA in which the importance and difficulty of denaturing the dsRNA was emphasized. We will also be using their strategy in attempts to clone dsRNA of RLSV.

All the funds have been spent from the project for 1987. I put more funds (about 3550) towards funding a student and (800) towards travel for collecting material for this project. This varies with the budget set out in the proposal for the year but we recieved some money for supplies from other sources. As a result we have been able to stockpile enough dsRNA to try many different cloning strategies and are more likely to succeed with the project.

PROPOSED RESEARCH:

Rapid assay systems available for plant viruses are based on serological reactions or complementary DNA (cDNA) hybridization tests. In the project I will try to develop a serological based test since these are easier tests to use in large scale applications. However, since raspberry is a difficult host to work with (as far as virus purification goes) it may not be possible to purify this virus directly from infected raspberry plants. If I can not find an alternate host for the virus it may be necessary to develop a cDNA based detection system rather than the preferred serological based systems. cDNA hybridization tests are used to detect potato spindle tuber viroid on a large scale and a similar approach could be used for RLSV.

The cloning of the RLSV dsRNA will continue throughout the winter and if successful we will field test the probes during the summer of 1988. If necessary we will continue cloning from the dsRNA during the summer of 1988. With the two new cloning strategies listed above I feel confident that we will be able to clone the RLSV before the summer of 1988.

DURATION OF PROJECT:

2/2 Year two to develop suitable probes and to field test the probes.

BUDGET:

03	Goods and services Enzymes, radioisotopes, X-ray film DNA binding paper, approximately an equal amount will come out of the Agriculture Canada research budget	3000
04	Travel	
	Travel to raspberry fields	350
	Partial costs of travel to an	

international small fruit virus conference to discuss these problems with other workers in the same field	1000
TOTAL	4350

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of
CALL FOR PROPOSALS

WASHINGTON RED RASPBERRY COMMISSION

Washington Red Raspberry Commission

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Randy Kraght
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George Tsugawa
Tyler Clark

Bryson Bailey
WA. State Dept. of Agriculture

Washington Red Raspberry Growers Association

Marvin Jarmin

Researchers Invited to Present Proposals

Peter Bristow, WWREC - WSU
Patrick Moore, WWREC - WSU
Robert A. Norton, NWREU - WSU
Carl Shanks, SWRU - WSU
Stott Howard, NWREU - WSU
Sarah Spade, IAREC - WSU
Alan L. Knight, OSU
Brian A. Croft, OSU
R. H. Converse, USDA-ARS - OSU
Robert R. Martin - Ag Canada

Department Chairs and Others

Paul Rasmussen, Dept. of Horticulture & Landscape Architecture, WSU
Jack Rogers, Dept. of Plant Pathology, WSU
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