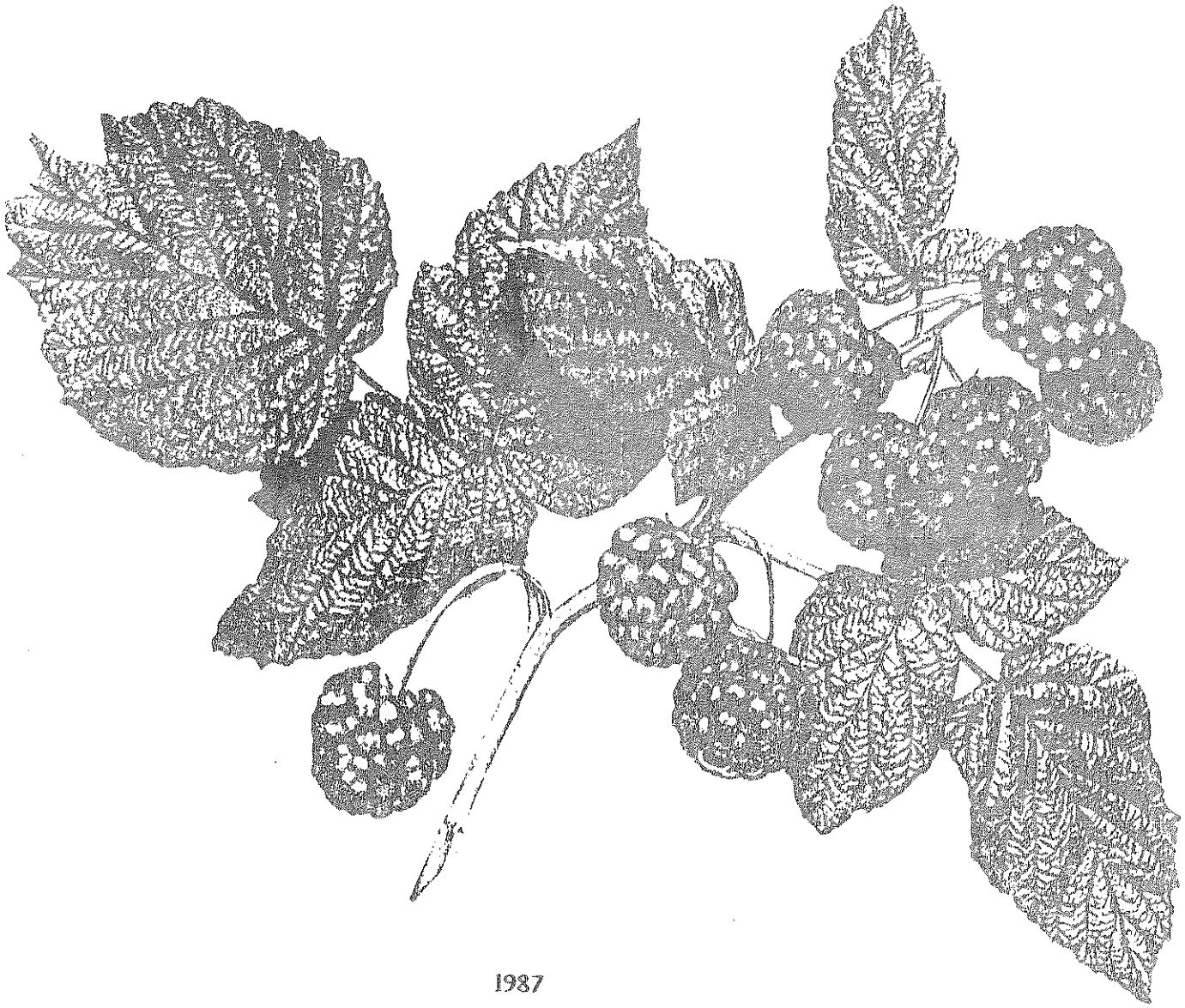

1987
RED RASPBERRY RESEARCH PROPOSALS

1986 PROGRESS REPORTS

to the

WASHINGTON STATE RED RASPBERRY COMMISSION

and

WASHINGTON RED RASPBERRY GROWERS ASSOCIATION

WASHINGTON STATE RED RASPBERRY COMMISSION

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SUMMARY

BUDGET REQUESTS

Project No.	Short Title	Lead Scientist	Amount Requested
	On-going Projects		
13C-3761-5668	Root rot screening techniques	Bristow	$ 1,900
13C-3755-6151	Advanced testing - raspberries	Sjulin	$ 1,458
13C-3755-7151	Breeding, Genetics, Clone Eval.	Sjulin	$ 6,360
13C-4740	New herbicides - raspberries	Howard	$ 1,346
13L-3028-4501	Mechanical harvesting	Simpson	$12,811
	Caneberry - orange tortrix (Request to carry forward balance)	Croft	
	New Projects		
	Irradiation - fruit rots	Bristow	$ 1,100
	Stability/performance of cultivars	Cameron	$ 3,400
	Irradiation - insect pests	Shanks	$ 600
	Spider mites	Shanks	$ 6,300
	Virus tested cultivars	Converse	$ 9,800
	Raspberry leaf spot virus	Martin	$ 4,350
		Sub-total	$25,550
	Final Project Reports		
13C-7361-6688	Waterlogging/root growth (Request to carry forward balance)	Bristow	-0-
13C-3761-7668	Soil compaction	Bristow	-0-
13C=3543-4959	Insecticides - honey bees	Shanks	-0-

WASHINGTON RED RASPBERRY COMMISSION
1986 Report and 1987 Proposal

PROJECT NO.: 13C-3761-5668

TITLE: Development of root rot screening techniques for red raspberry

PERSONNEL: Peter R. Bristow, Associate Plant Pathologist, WWREC, Puyallup
Thomas M. Sjulin, Assistant Horticulturist, WWREC, Puyallup

JUSTIFICATION:

Root rot, caused by Phytophthora erythroseptica, continues to increase in incidence and severity in the red raspberry production regions of the Pacific Northwest. The fungicide metalaxyl (Ridomil) effectively controls this serious disease. Development of resistant cultivars, however, appears to be the most promising long-range solution to this problem. High levels of root rot resistance have been identified, but only the cultivar 'Sumner', with moderate resistance, has acceptable commercial horticultural characteristics. Current methods used to screen seedlings for resistance (field testing) are time-consuming and limit the number of seedlings that can be tested at one time. A technique for inoculating seedlings with the pathogen under greenhouse conditions appears very promising, but the severity of the test has been difficult to regulate. Susceptible seedlings can be identified and the resistant ones carried on for evaluation of horticultural traits.

OBJECTIVES:

1. To develop a rapid, reproducible screening technique for evaluating root rot resistance in large populations of raspberry seedlings.

2. To determine the inheritance of resistance to P. erythroseptica in red raspberry.

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

PROGRESS:

Six plants, which survived the inoculation tests in 1984 and have been growing in a field naturally infested with P. erythroseptica (at SWRU) since then, were selected for further horticultural testing. The survivors from the 1985 inoculations were evaluated in the field for the first time in 1986. Many of these showed no symptoms of root rot, while control cultivars susceptible to the disease exhibited root rot symptoms.

In early 1986 over 3,000 seedlings were screened using the greenhouse inoculation procedure. The results are summarized in Table 1. All survivors plus plants of control cultivars were planted at SWRU this summer and will be evaluated in 1987 and 1988. Resistance from Rubus strigosus (North American red raspberry) may have been underestimated because seeds used were probably derived from outcrossing with other red raspberries. Variation within populations of R. parviflorus (western thimbleberry) and R.

spectabalis (salmonberry) suggest that selecting the more resistant clones of these two species might be useful.

PROPOSED RESEARCH:

Regulating the severity of the greenhouse-seedling inoculation technique continues to be troublesome. Further refinements are needed, particularly in standardizing inoculum potential. It may be necessary to conduct these tests in growth chambers rather than in the greenhouse so greater control of the environment can be maintained.

The present test has been developed for use with seedlings. However, there is a need to test plants derived from rooted cuttings.

Resistance found in populations of R. strigosus from various regions of North America needs further evaluation. This material has the potential of combining root rot resistance with fairly good horticultural traits. R. strigosus also freely crosses with red raspberry, whereas R. glaucus and R. sumatranus, two introduced species which are highly resistant to root rot, probably do not cross readily.

DURATION OF PROJECT:

0668 and 0640; June 30, 1988 expiration for both.

DURATION OF THIS PROPOSAL:

One year; March 1987 to March 1988

BUDGET:

	Current 1986-87	Proposed 1987-88
01 Wages (timeslip labor)	$1,800	$1,200
03 Supplies and Services	684	262
04 Travel	300	300
05 Computing services		30
07 Benefits (9% of Item 01)	216	108
TOTAL	$3,000	$1,900

Table 1. Survival of red raspberry and other Rubus species seedlings to inoculation with Phytophthora erythroseptica.

Parent genotype	No. seedling populations	No. inoculated	No. survival	Percent survival
a) Red raspberry	16	1660	113	7
b) Open-pollinated Rubus species:				
'Brandywine'[z]	1	31	18	58
'Prestige'[y]	1	26	17	65
R. crataegifolius	1	215	33	15
R. ideaus	1	43	9	21
R. illeacebrosus	1	9	8	89
R. leucodermis	2	11	0	0
R. parviflorus	4	283	122	43
R. parvifolius	1	20	14	70
R. spectabilis	4	474	376	79
R. strigosus	3	244	116	48

[z] Black raspberry x red raspberry

[y] Red raspberry x R. pungens oldhami

PROJECT NO.: 13C-3755-6151

TITLE: Advanced Testing of Washington State University Raspberry Selections

PERSONNEL: Thomas M. Sjulin, 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.

Harvest data for 1985 and 1986 averaged across the 3 locations are given in Table 1. Yields in 1985 did not differ, but

WSU 696 outyielded all other genotypes in 1986 except WSU 608 and Meeker. The yield of WSU 737 in 1986 was less than all other genotypes, primarily due to severe winter injury. Fruit weights of WSU 737 and WSU 738 were greater than all other genotypes except WSU 696 in both years. All selections ripened in the Meeker season or later. In 1986, Chilcotin ripened in the Willamette season at Vancouver, but was in the Meeker season at Puyallup and Mount Vernon. Preharvest fruit rot did not differ among genotypes either year when averaged over all locations. However, rot was higher in WSU 608, WSU 696 and WSU 738 than all other genotypes in 1986 at Puyallup.

The effect of location on fruit quality was determined in both 1985 and 1986. In 1985, differences among genotypes for ease of picking, soluble solids and anthocyanin pigment content were not consistent across the 3 locations. Differences among genotypes for firmness and titratable acidity were consistent. WSU 737 (251 g) was firmer than all other genotypes except WSU 738 (234 g) and WSU 696 (232 g). Acidity of Chilcotin (287 ml NaOH/100 g) was higher than all other genotypes. Meeker (175 ml) and WSU 735 (172 ml) were lowest in acidity. The 1986 fruit quality data have not yet been analyzed.

WSU 738 is recommended for variety release pending evaluation of certified plant stocks for crumbliness and positive evaluations in grower trials in 1987. WSU 608 is being propagated for grower trials as a potential processing variety with high yields, disease resistance and winter hardiness. Machine harvest trials of WSU 608 in Vancouver in 1986 were disappointing, but these trials will be repeated in 1987. WSU 737 is difficult to pick and susceptible to root rot and winter injury, and will be used only for breeding purposes. WSU 696 will also be used only for breeding, due to its difficult pick and low sugar-high acid balance. WSU 735 will be discarded due to its small size, lower yields and lower firmness.

PROPOSED RESEARCH:

Work on this project will be coordinated by JoAnn Robbins, Agric. Res. Tech. III at WWREC, Puyallup, until a replacement for T. M. Sjulin is hired.

WSU 608 and WSU 738 plus the 3 standard varieties, will be hand harvested at weekly intervals in 1987 for yield, fruit weight and preharvest rot. WSU 696, WSU 735 and WSU 737 will be discarded from these trials.

New plantings will be established at all 3 locations in spring, 1987. Included will be WSU 892, a promising Cherokee by

Skeena selection for machine harvest/processing purposes, WSU 940, an apricot-colored selection for fresh market purposes, plus additional selections from Agriculture Canada and Oregon State University programs, and standard varieties.

TERMINAL DATE OF BASE PROJECT:

June 30, 1988

DURATION OF PROPOSAL:

Final year of a three-year project. A new project will probably be initiated in 1987 by T. M. Sjulin's replacement.

BUDGET:

01	Time Slip	$1200
03	Supplies and Services .	150
07	Benefits (9% of 01) ...	108
	Total	$1458

The budget would be divided equally among the project leaders at each location ($486 apiece).

Table 1. 1985-86 evaluations of WSU advanced red raspberry selections.[z]

	Marketable yield (tons/acre)		Fruit weight (grams/fruit)		Midpoint of harvest		Fruit rot (%)	
Selection	1985	1986	1985	1986	1985	1986	1985	1986
WSU 608	6.7 a[y]	6.3 ab	3.3 c	3.7 bc	July 14 c	July 4 bc	0.2 a	1.8 a
WSU 696	7.0 a	7.2 a	3.6 bc	4.2 ab	July 16 abc	July 8 a	0.6 a	1.6 a
WSU 735	5.3 a	4.7 b	2.6 d	3.0 d	July 18 a	July 7 ab	0.2 a	0.7 a
WSU 737	6.6 a	2.2 c	3.9 ab	4.5 a	July 15 bc	July 7 abc	0.1 a	1.1 a
WSU 738	6.4 a	5.1 b	4.1 a	4.6 a	July 18 ab	July 5 abc	0.6 a	2.0 a
Chilcotin	5.6 a	5.3 b	3.3 c	3.9 bc	July 11 d	July 3 c	0.3 a	0.8 a
Meeker	6.0 a	5.5 ab	3.1 c	3.8 bc	July 15 bc	July 4 bc	0.1 a	0.6 a
Willamette	5.5 a	4.7 b	3.4 c	3.5 c	July 8 d	June 29 d	0.1 a	1.0 a
Genotype by location	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-3755-7151

TITLE: Red Raspberry Breeding, Genetics and Clone Evaluation

PERSONNEL: Thomas M. Sjulin, Assistant Horticulturist; JoAnn Robbins, Agric. Research Technologist III; Laura Quirie, Technical Farm Laborer 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:

A. 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.

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

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

PROGRESS:

WSU 738 (Meeker X Skeena) was evaluated in grower trials established in 1985. Winter injury was severe in many locations in the Puyallup Valley and further north. However, growers who

did fruit this selection in Oregon and Washington were very impressed with its large size and good fresh market potential. Fruiting canes appeared to compensate well to the winter injury and produce yields comparable to Meeker and Willamette. Crumbly fruit of WSU 738 was observed in British Columbia grower trials. This crumbliness was not associated with virus infection and is thought to be due to an off-type clone propagated by tissue culture.

WSU 608 (BC 64-6-169 X Haida) was evaluated in comparison to Willamette in machine harvest trials at SWRU, Vancouver. WSU 608 significantly outyielded Willamette (1.20 T/A versus 0.71 T/A), but much potential yield of WSU 608 was not recovered. The poor fruit recovery from WSU 608 appears to be due to its weak laterals bending under the fruit load.

The results of variety and selection evaluations at Puyallup are presented in Tables 1 and 2. Yields of Meeker, Willamette, ORUS 1836 and WSU 738 were severely reduced by winter injury. WSU 608, WSU 696, BC 72-1-7, BC 74-11-41, Chilliwack, Comox and Schoenman showed little winter injury and yielded well. Comox, a 1986 release from Agriculture Canada, BC, was highly susceptible to root rot. SCRI 6820/41, a sister selection of the root-rot susceptible variety Glen Prosen, showed unexpectedly high resistance to root rot.

The most promising new WSU selection evaluated in 1986 was WSU 892, a Cherokee X Skeena selection with an outstanding combination of winter hardiness, picking ease and appearance. Fruit of WSU 892 are very glossy and retain their shape in the cannery flats. Soluble solids of WSU 892 were identical to Willamette (7.4%), but fruits were less deeply pigmented. Virus-free stock of this selection is now being propagated for regional experiment station and grower trials.

WSU 940 (ORUS 1846 X ORUS 576-47), an apricot-colored raspberry selected in 1985, showed good winter hardiness and produced attractive, firm fruit of very good quality. Due to the high interest in yellow-fruited raspberries for the fresh market and the lack of suitable varieties, this selection is now being propagated for advanced testing.

Six additional WSU selections that fruited for the first time in a replicated trial appear to have very good combinations of winter hardiness, yields, fruit weight, firmness and quality (Table 2). Five of these (WSU 878, WSU 901, WSU 902, WSU 908 and WSU 909) share SCRI 6820/41 as one parent, and have shown little root rot injury in the past 2 seasons.

Six new selections were made from seedlings surviving natural infection by root rot at SWRU, Vancouver. These selections showed good combinations of fruit quality with root rot resistance, but most are expected to have greater potential as parents than as varieties. Additional selections will be made this fall from seedlings evaluated at Puyallup. Selections were not screened for aphid resistance.

In addition to 1660 seedlings screened for resistance to Phytophthora root rot (see Bristow and Sjulin report on root rot screening), 1235 seedlings from 26 crosses and 280 open-pollinated seedlings of 9 Rubus species were planted at Puyallup. Thirty-eight new crosses were completed in 1986. The objective of most crosses was to combine aphid resistance, root rot resistance, winter hardiness, higher yields, larger size, greater firmness and higher fruit quality. Most crosses were among promising WSU and Agriculture Canada selections that showed relatively little winter injury following the November, 1985 freeze.

The relationship of plant growth habit to winter hardiness was examined in a replicated planting of 61 varieties and selections. The percent of upright canes and the percent leaf drop, both recorded within 2 weeks of the November, 1985 freeze, were significantly correlated with lateral emergence ratings made in April, 1986. The more upright growth habit and greater leaf drop was thus associated with less winter injury. Measurement made on individual canes of tender varieties such as Meeker and Willamette supported the relationship of cane position to winter injury. Canes of these varieties that were laying horizontally at the time of the freeze showed more visible bud injury than upright canes.

A scanning electron microscopy study of raspberry fruit structure and its relationship to fruit strength was completed by JoAnn Robbins as part of her Ph.D. thesis. Surface hairs between the individual drupelets of raspberry fruit are thought to be the major morphological feature holding fruit together. These hairs differed in length and density among several varieties. However, the fruit strength of these varieties was more closely related to the total contact area between individual drupelets, rather than the density or length of the hairs. Surface hairs tend to produce a dulling "bloom" on the fruit surface. This study indicates that we can select less hairy, glossier fruits without sacrificing fruit strength.

The inheritance of fruit weight, firmness and retention strength (ease of harvest) was examined in a population of 240 seedlings from 15 crosses among 10 parents. The heritability estimates indicate that genetic improvement should be relatively

rapid for all 3 traits. A relatively high genetic correlation was observed between fruit weight and retention strength, indicating that selection for larger fruit will tend to increase the difficulty of harvest. Simultaneous selection for both larger fruit and ease of harvest should avoid this problem.

Virus-free propagation beds of 5 leading varieties, 3 WSU advanced selections and 2 new Agriculture Canada, varieties (Chilliwack and Comox) were established at Puyallup. Plants of WSU 738, Chilliwack and Comox were distributed to all Washington certified plant propagators. In addition, plants of WSU 608 were given to one propagator to produce stock for grower trials.

PROPOSED RESEARCH:

Work on this project will be coordinated by JoAnn Robbins until a replacement for T. M. Sjulin is hired.

Grower trials of WSU 608 will be established in at least 3 locations in Washington.

WSU 738 planting stock from Washington certified plant propagators will be tested for freedom from crumbly fruit by fruiting out sample plants at Puyallup, The WSU 738 grower trials will be observed again in 1987, and the naming and release of WSU 738 will begin after the 1987 season, assuming no serious problems are encountered.

Seedlings from 1986 crosses will not be prescreened for aphid or root rot resistance, and will be planted at Puyallup.

Relatively few new crosses will be made in 1987. Crosses will be made to introduce root rot resistance from several Rubus species. Additional crosses will be made among an elite group of WSU and Agriculture Canada breeding material.

Selections made in 1986 will be planted along with standard varieties in replicated yield trials and root rot evaluation plantings at Puyallup.

WSU, Agriculture Canada and OSU-USDA selections previously established in replicated selection trials will be evaluated for yield, fruit weight, firmness, season of ripening and preharvest rot.

A replicated planting of 10 Willamette clones will be evaluated for yield, fruit weight, firmness, season of ripening and preharvest rot. Eight of these clones are from older commercial

plantings in western Washington, and 2 clones are from certified planting stock.

WSU 892 and WSU 940 raspberry selections will be distributed for regional advanced testing, and propagated for grower trials.

A machine harvest trial of WSU 608, WSU 892, Chilliwack, Comox, Meeker and Willamette will be established at Puyallup and in Whatcom County.

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: June 30, 1988

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

BUDGET:

01	Timeslip labor	$4000
03	Supplies and services	2000
07	Benefits (9% of 01)	360
	Total	$6360

Table 1. 1984-1986 evaluations of 1982-planted raspberry selections at Puyallup.

Selection	Total yield (tons/acre)			Fruit weight (grams/fruit)			Fruit firmness (grams)			Harvest midpoint			Fruit rot (%)		
	1984	1985	1986	1984	1985	1986	1984	1985	1986	1984	1985	1986	1984	1985	1986
a) Replicated selections.[z]															
Meeker	8.4 a[y]	8.0 ab	3.4 b	3.5 cde	3.2 a	4.4 a	155 ab	226 b	132 a	July 17	July 19	July 1	0.5 de	0.4 a	1.1 a
Titan	7.0 a	9.4 a	-[x] d	4.9 a	4.2 a	-	111 c	191 b	-	July 10	July 11	-	2.8 b	0.3 a	-
Willamette	6.0 a	4.6 b	2.4 b	3.6 cd	3.5 a	3.4 a	116 bc	218 b	123 a	July 9	July 8	June 24	1.1 de	0.3 a	3.0 a
SCRI 6820/64	8.8 a	6.8 ab	-[w]	3.4 cde	2.7 a	-	166 a	223 b	-	July 13	July 15	-	2.2 bc	0.3 a	-
WSU 608	8.6 a	10.6 a	5.2 a	3.3 de	3.4 a	3.9 a	126 abc	183 b	111 a	July 6	July 16	July 2	1.5 cd	0.5 a	3.0 a
WSU 737	5.4 a	3.8 b	-[w]	4.5 ab	3.9 a	-	164 a	292 a	-	July 17	July 16	-	0.3 e	0.2 a	-
WSU 738	8.4 a	8.2 ab	2.0 b	4.0 bcd	3.2 a	3.7 a	108 c	178 b	124 a	July 17	July 17	July 3	0.4 e	0.1 a	2.2 a
b) Non-replicated selections.															
Chilliwack	8.0	5.4	3.4	3.7	3.5	3.8	-	259	178	July 12	July 17	July 1	0.4	0.0	1.1
Comox	7.6	6.8	2.2	3.7	3.0	3.0	160	205	173	July 13	July 13	June 30	0.9	0.8	2.4
Glen Moy	2.4	6.6	-[w]	4.0	3.8	-	118	207	-	July 3	July 9	-	2.4	1.3	-
Schoenman	6.2	-	8.2	3.8	-	4.3	150	-	96	July 18	-	July 3	0.4	0.0	2.4
BC 74-11-41	4.6	9.0	6.8	3.0	2.9	3.4	117	244	103	July 11	July 16	July 3	2.0	0.3	2,1
BC 74-12-7	8.2	6.0	4.6	3.3	2.7	3.2	152	210	163	July 15	July 19	July 4	0.5	1.1	0.9
ORUS 573-38	5.8	3.2	1.6	3.7	3.0	2.3	142	212	158	July 9	July 12	June 29	0.9	0.0	0.9
ORUS 576-48	5.6	4.8	-[w]	3.6	2.5	-	173	256	-	July 13	July 15	-	1.3	0.8	-

[z] Mean of three 3-hill plots.

[x] Plots not harvested due to poor fruit quality.

[w] Plots not harvested due to severe winter injury.

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

Table 2. Evaluations of 1984-planted raspberry selections at Puyallup, Washington.[z]

Selection	Marketable yield (tons/acre)	Fruit weight (grams/fruit)	Fruit firmness (grams)	Midpoint of harvest	Fruit rot (%)	Root rot (%)		Subjective evaluations (0-10 scale)			
						1985	1986	Picking ease	Appearance	Color	Flavor
Chilcotin	1.4 cde[x]	3.3 a-g	81 cde	July 1 g-k	10.2 c	0.5 d-g	14.6 c-j	8	6.3	6.7	6
Chilliwack 74-108-81	2.8 a-e	2.9 b-i	158 ab	July 2 e-k	3.1 def	1.9 d-g	14.4 d-j	7	5.3	5.7	6.5
Comox 74-12-42	2.5 a-e	3.7 a-d	159 ab	July 4 c-i	5.8 c-f	15.4 b-f	56.6 b-e	5	5	5	5
Meeker	1.0 de	2.8 b-i	84 cde	June 30 ijk	3.7 def	0.0 efg	30.0 c-j	5	5.8	5.7	7.2
Skeena	2.4 a-e	2.8 b-i	112 b-e	July 1 f-k	5.3 c-f	6.8 b-g	25.2 c-j	6	5.3	5.3	6
Sumner	0.5 e	2.4 ghi	61 e	June 30 h-k	6.6 c-f	1.7 d-g	10.0 d-j	3	4.7	5.3	6.7
Willamette	0.4e	2.5 e-i	102 cde	June 28 k	7.5 c-f	0.3 efg	24.6 c-j	6	3.5	4	6
ORUS 1836	-	-	-	-	-	7.2 b-g	21.7 c-j	-	-	-	-
ORUS 2078	-	-	-	-	-	1.9 d-g	18.7 c-j	-	-	-	-
ORUS 520/48	-	-	-	-	-	1.5 d-g	20.1 c-j	-	-	-	-
SCRI 6820/41	2.6 a-e	3.1 a-i	177 a	July 6 b-3	8.5 cde	0.3 efg	0.0 j	6	6	5.7	5.3
WSU 738[y]	1.1 de	3.6 a-e	95 cde	July 6 c-f	4.8 c-f	1.1 d-g	10.3 d-j	4	6.3	6.2	6.8
WSU 878[y]	4.8 a	3.5 a-f	113 b-e	July 10 ab	1.9 f	0.0 efg	29.0 c-j	3	7.7	6.7	6.3
WSU 892[y]	3.1 a-e	3.6 a-d	173 a	July 1 g-k	2.4 ef	1.7 d-g	0.7 hij	7	6.7	5.8	5.5
WSU 896[y]	3.2 a-e	3.3 a-h	102 cde	July 4 d-i	5.1 c-f	11.9 b-g	53.9 b-g	4	6	5	7
WSU 901[y]	2.8 a-e	4.1 a	185 a	July 4 d-i	7.4 c-f	0.0 g	3.8 e-j	6	7	6.3	5.3
WSU 902[y]	3.6 a-d	3.8 ab	158 ab	July 9 abc	3.8 def	0.4 efg	1.4 hij	4	6.7	5.3	5.3
WSU 908[y]	4.0 abc	3.7 abc	125 bc	July 12 a	3.7 def	0.1 fg	2.9 e-j	5	6.7	5	6.7
WSU 909[y]	3.2 a-e	3.6 a-e	103 cde	July 5 c-i	4.2 c-i	0.0 g	7.4 e-j	5	6.7	5.7	6

[z] Harvest data is mean of two 4-hill plots; root rot data is mean of 4 single-hill plots.

[y] WSU 738, WSU 896 = Meeker X Skeena; WSU 878 = SCRI 6820/41 X WSU 684; WSU 892 = Cherokee X Skeena; WSU 901, WSU 902 = SCRI 6820/41 X Skeena; WSU 909, WSU 909 = SCRI 6820/41 X WSU 738.

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

PROJECT NO: 13C-4740

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, Mount Vernon, Washington.

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 due to potential ground water contamination (simazine, pronamide and alachlor), it is important to evaluate alternative/replacement 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 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 raspberry.

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 pyridate (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.

Asulam, clopyralid, oxyfluorfen, and prodiamine were applied at two rates each, and napropamide at one rate, on March 28, 1986 (cinmethylin, lactofen, and pyridate are to be applied this fall as they are better suited for fall/dormant applications and will be evaluated through next season). All standard red raspberry production practices were followed.

Evaluations of yield, weed control, and crop phytotoxicity from the Willamette and Meeker plots are promising. There were no reductions in

yield when compared to the napropamide treated plots. In addition, there were no visual observations of crop phytotoxicity from any of the treatments. Because of this we are encouraged to pursue repeated applications to these same plots over time to ensure the reliability of these first-year phytotoxicity evaluations.

The weed control obtained from these treatments was very acceptable. Even those materials not known for their soil persistence performed well. This is attributed to good early-season weed control, coupled with a vigorous crop canopy later in the season which prevented weed growth by virtue of competition. Evaluations were made on June 6, 1986 and again on October 6, 1986. All treatments were more efficacious on early as compared to later weed control evaluations, however, more treatments still provided adequate late-season weed control.

All of these observations and data mean very little in terms of potential registrations. Although there is interest on the part of the chemical manufactures, one data year in weed control and crop phytotoxicity for a particular herbicide is only a portion of the information needed. We are, however, very encouraged by these results and are anxious to continue these efforts.

PROPOSED RESEARCH:

Additional funds are requested in order to continue testing of clopyralid, prodiamine, oxyfluorfen, and asulam on red raspberries. It will be important to continue application of these herbicides to the same plots in order to determine problems of persistence leading to phytotoxicity or development of weed problems specific to particular herbicide's repeated use.

TERMINATION DATE OF BASE PROPOSAL: Fall 1987

DURATION OF THIS PROPOSAL: Through Fall of 1987

BUDGET:

		1986-87	1987-88
01	Time slip	$1,800	$ 800
03	Supplies and Service	800	250
04	Travel	84	---
05	Computer	100	200
07	Benefits	216	96
	TOTAL	$3,000	$1,346

Trade Name Herbicide	(ai/A)	Yield*		grams/25 berries*		Weed Control	
		Willamette	Meeker	Willamette	Meeker	6-11-86	10-6-86
weedy check		3924a	4276a	2.46a	3.58a	0.0	0.0
napropamide	4	3544a	3838a	2.67a	3.45a	10.0	9.5
clopyralid	0.2	3888a	4299a	2.79a	3.41a	10.0	9.3
clopyralid	0.4	3871a	4028a	2.85a	3.60a	10.0	8.8
prodiamine	2	3081a	4054a	3.28a	3.64a	9.8	6.3
prodiamine	4	3901a	3566a	2.90a	3.75a	10.0	8.8
oxyfluorfen	1	3750a	3464a	3.19a	3.45a	9.5	8.0
oxyfluorfen	2	2920a	3692a	2.50a	3.23a	10.0	9.0
asulam	2	3431a	3555a	3.05a	2.97a	9.0	8.3
asulam	4	3792a	3895a	2.98a	3.75a	9.0	9.3

* Column means followed by the same letter are not significantly different (P=0.05) according to Duncan's multiple range test.

PROJECT NO: 13L-3028-4501

TITLE: Reducing Losses from Mechanically Harvested Raspberries

PERSONNEL: J. B. Simpson, G. M. Hyde, H. Waelti, R. E. Thornton
C. MacConnell, J. E. George

JUSTIFICATION:

Research conducted during the 1986 harvest season substantiated the fact that berry losses during mechanical harvesting represents a serious economic loss to growers. Machine losses varied from 12.9 to 29.3 percent with average losses of approximately 22%. These losses are fairly consistent with studies conducted in Scotland which showed machine losses varying from 15 to 25% (Cormack and Waister, 1976a). Total losses approached 30% of the crop when between harvest losses were added to the mechanical harvest losses. Losses are also incurred from damage to primocanes which result in yield reductions in the subsequent crop (Cormack and Waister, 1976b). Improvements in the performance of mechanical raspberry harvesters will be of benefit to the entire red raspberry industry.

OBJECTIVES:

1. Determine the effects of beater frequency and forward speed on berry detachment and mechanical harvest losses.

2. Develop operating procedures and modifications in harvesting machines and/or cultural practices to reduce mechanical raspberry harvest losses.

PROGRESS:

Loss studies were conducted on three makes of mechanical raspberry harvesters plus one modified machine during the 1986 harvest season. Average harvester losses amounted to 161 lb. per acre per picking, representing an annual harvester loss of approximately 2,000 lb. per acre. These losses were determined from replicated tests for two pickings for three growers and from single pickings for two growers from July 10-14, 1986. Between harvest losses amounted to another 56 lb per acre for a 2-day picking interval in cool weather, 194 lb per acre for a 3-day interval in which one day was quite warm.

All machines were operated in a normal manner with operating speeds and beater frequencies selected by the operators. Only one machine varied ground speeds between test runs. No firm

conclusions can be drawn from the limited number of tests with this machine but it is interesting to note that for one set of tests berry losses averaged 20.0% when operating at 0.75 mph, but only 14.9% when operating at 1.9 mph. Collected berries was also higher at the higher operating speed.

PROPOSED RESEARCH:

The effect of beater frequency and amplitude on berry detachment will be analyzed for northwest conditions during the 1987 harvest season. Observed frequencies varied from 0.8 to 2.5 HZ for the 1986 test period, with no attempt made to determine the effect of frequency on berry detachment. Most machines observed during the 1986 season operated at forward speeds of from 0.6 to 0.8 mph. The effect of forward speed needs to be addressed in more detail since speeds are related to machine capacities and to machine operating costs as well as to the performance of the detachment and collection systems. Improved operating procedures will be developed if it is determined that operational changes can lead to significant improvements in the overall performance of existing machines.

The location and magnitude of berry losses within harvester collection systems will be studies to assist in identifying potential detachment and collection system refinements. Machine modifications will be developed for use during the 1988 harvest season. Other harvester collection systems will also be evaluated, as will alternate cane support systems. Cooperation with other researchers, growers, and manufacturers will be essential for progress.

DURATION: 3 years

BUDGET:

		Current 1986-87	Proposed 1987-88
00	Salaries ..... .25 FYE Technician	$ 0	$7,500
01	Wages	2,000	400
03	Goods & Services	1,000	1,000
04	Travel	2,000	2,000
07	Benefits	260	1,911
		$5,260	$12,811

REFERENCES:

Cormack, M. R. and P. D. Waister. 1976a. Sources of yield loss in machine harvested raspberry crops. Acta Hort. 60:21-25.

Cormack, M. R. and P. D. Waister. 1976b. Effects of machine harvested raspberries on yield in the following year. Hort. Res. 16:121-129.

October 14, 1986

Arlen Davison, Supt.
Washington State University
WWREC
Puyallup, WA 98371-4998

Dear Arlen:

Thank you for your note of October 7 inquiring of the status of our Washington State Red Raspberry Commission grant. Our work was to produce a bulletin relating to caneberry management and the orange tortrix. In this regard, Alan Knight completed a rough draft of the proposed bulletin. However, after having it reviewed by extension related research people in Washington and Oregon, we question whether an Extension Bulletin is the appropriate vehicle to release this information. Since that time we have pursued publishing a Research Bulletin (that would be used by growers). As yet, we have not clarified what the exact position of the University Publications office is on this question.

As to the grant that was made to support publication of this material, we are holding it in an account. As a decision is made on the publication, we will use that money in support of publishing this material. I will inform you later of our progress in publishing the material on our research.

Sincerely yours,

Brian A. Croft
Professor

dmw

PROJECT NO.: USDA ARS Trust Fund 12-14-5001-705

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 1986: August Red-85HT, Amity-86, Amity-85M, Canby-81M, Chilcotin-86M, Heritage-79, Heritage-86M, Meeker-81M, Skeena-79, Willamette-80M. The following ORUS Rubus selections were heat-treated, meristem-propagated, increased and released to requesting scientists and cooperating nurseries in 1986: ORUS 2033 ORUSM 250, ORUS 1658, ORUS 1658 ORUSM 1658, ORUS 1835 ORUSM 37, ORUS 1836 ORUSM 162, ORUS 2078, ORUS 520-48 ORUSM 176, ORUS 576-47 ORUSM 191.

b) Explants (identified below by ORUSM numbers or USDA-ARS selection numbers) that were developed in 1986 by high carbon dioxide-100 micron shoot-apex culture included: ORUS 534-10, ORUS 573-38, ORUS 932-2, ORUS 2078 ORUSM 266 and 267, ORUS 2033 ORUSM 250. These plants are currently being increased in the screenhouse for 1987 horticultural evaluation or continuing 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 Dr. Thomas Sjulin, Fallgold (recommended for the meristem program by Dr. Francis Lawrence due to increased interest from growers), ORUS 680-1, ORUS 1734, and ORUS 744-Z.

d) Using antisera supplied by a colleague from Scotland, we were able to detect a major virus in the raspberry mosaic complex (black raspberry necrosis virus) from infected Willamette plants by enzyme-linked immunosurbent assay (ELISA), an overnight method. The testing of cultivars from the field for this virus is in progress. This is a significant improvement in the speed and accuracy of detecting this virus over the standard leaf graft analysis that takes 6 weeks and is less reliable.

e) The superior Willamette clones collected by Dr. Thomas Sjulin at WWREC were sent to me for virus evaluation. This has been completed and only a few of the clones were infected, mostly with graft-transmissible entities that do not match known

reactions. When Dr. Sjulin identifies the best of the Willamette clones that he has collected, we will proceed to heat treat and shoot apex culture them for increase and release to requesting State Departments of Agriculture.

PROPOSED RESEARCH:

a) Heat-treat in a high carbon dioxide atmosphere, shoot-apex, virus index, and screenhouse-propagate cultivars and selections identified in 6c above, and horticulturally superior clones of Willamette that may be identified from Washington State University by Dr. Thomas Sjulin.

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

c) Evaluate field-grown raspberry cultivars by ELISA for detection of members black raspberry necrosis virus.

DURATION OF PROJECT:

Ongoing. The time period of this particular proposal is calendar 1987.

BUDGET:

Research Assistant (0.35 (FTE)	$6,200
Employee benefits (OPE at 32%)	2,000
Mandatory ARS 10% overhead on $8,000	800
Mandatory OSU 10% overhead on $8,000	800
TOTAL	$9,800

We suggest that this budget be made available to the U.S. Department of Agriculture, Agricultural Research Service for Trust Fund No. 12-14-5001-705. A recent administrative ruling now increases our costs by 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 budget request increase reflects this change. Please note that the continuing ability of our research project to supply virus-tested raspberry stock to industry rests on the ability of the Washington Raspberry Commission and the Oregon Caneberry Commission to support the technical assistance needed to produce these plants.

WASHINGTON RED RASPBERRY COMMISSION

PROJECT NO.: 13C-7361-6688

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 to early spring when root growth resumes. Then, 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 the time of flooding and also the duration of flooding 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, Skeena 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 as 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:

Because disease-free tissue culture propagated plants of the three test cultivars could not be delivered when needed, I decided to postpone this project for one year. Mr. David Kile was notified in July of the decision to postpone.

I am requesting that the project be extended until March 31, 1988. No additional funds are required for the coming fiscal year.

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

DURATION OF THIS PROPOSAL:

One year, but funds may be requested for 1988-1989

BUDGET:

Amount allocated for 1986: $2,210.00

Balance as of July 31, 1986: $2,210.00

WASHINGTON RED RASPBERRY COMMISSION

PROJECT NO.: 13C-3761-7668

TITLE: Effect of soil compaction on root distribution, cane growth and yield in red raspberry

PERSONNEL: Peter Bristow, Associate Plant Pathologist, WWREC, Puyallup
Joseph Braun, Assistant Horticulturist (resigned), SWRU, Vancouver
Charles Brun, Extension Agent-Horticulturist, Clark County

JUSTIFICATION:

It has been clearly demonstrated that soil compaction adversely affects growth and yield of several crop plants. Red raspberries may be significantly affected, especially in fields mechanically harvested. Roots of the red raspberry plant may be unable to penetrate compacted areas due to increased physical strength of soil and limited oxygen supply. Compacted soils are more prone to waterlogging and the associated damage to roots. Damage from root diseases, caused by soil-borne fungi and/or nematodes, may be enhanced when the root system is limited by soil compaction.

OBJECTIVES:

1. To determine the influence of soil compaction on cane growth, yield and root distribution.

2. To investigate competition between primocanes and fruiting canes as affected by soil compaction.

3. To evaluate the effect of a permanent cover crop on soil compaction and response by red raspberry to soil compaction.

PROGRESS: (Final Report)

Red raspberries (cv. 'Meeker') were established (1981) on a silt loam soil and subjected to multiple passes of machinery to simulate the effects of soil compaction due to a mechanical fruit harvester and grown with and without a perennial ryegrass cover crop in the alleyway between the rows. After three seasons of fruit collection (1983-5), only the combination of compaction and cover crop significantly ($P < .05$) lowered yield. Fruit size was reduced by both compaction and cover crop. Primocane growth (number and size) was not affected by treatment. Compaction markedly reduced the emergence of suckers within the alleyway; cover crop alone also significantly reduced emergence in this region.

Soil moisture levels were markedly lower (drier) adjacent to plants in compacted plots despite frequent overhead irrigations. This was due to the greater i) total length of roots and ii) density (length of root per unit volume of soil) of roots beneath and immediately adjacent to the plants in

compacted plots. Dry bulk density of the soil and soil strength (penetration resistance) were markedly higher beneath the wheel tracks than in the equivalent position in non-compacted plots. Root density was reduced to a depth of 8-12 inches immediately beneath wheel tracks. Below that depth (12-24 inches) root density actually increased compared to the non-compacted control as the root system grew beneath the compacted band of soil.

Growing red raspberries with a band of compacted soil on either side of the plant may be similar to growing plants in a pot; it can be done if close attention is given to nutrition and moisture. The margin for error, however, may be markedly reduced compared to the field situation where there is no compaction. For commercial growers who harvest by machine it may be practically impossible to meet the demands necessary to produce profitable high yields year after year when the volume of soil available to the roots of the plant is limited by soil compaction.

A report on fruit yield, cane growth and soil strength was made at the 1986 Annual Meeting of the Western Washington Horticultural Association. A report on the root distribution portion of this experiment will be made at the 1987 meeting.

TERMINATION DATE: March 31, 1987

PROJECT NO.: 13C-3543-4959 (1957)

TITLE: Effect of some insecticides on honey bee mortality and foraging behavior on raspberries.

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

Daniel F. Mayer
Irrigated Agricultural Research and Extension Center

JUSTIFICATION:

It is well known that honey bees are necessary for pollination of red raspberries. Some insecticides applied during bloom for control of leafrollers and adult root weevils can either kill bees or affect their foraging behavior, reducing the numbers of honey bees in the field. While it is recommended that use of insecticides be kept to a minimum during raspberry bloom, occasionally it is necessary to make such applications in order to derive maximum pest control. An example is application of a non-systemic insecticide to kill young orange tortrix larvae before they can become protected by rolled leaves.

Some insecticides tested during the past year have shown promise for control of leafrollers and adult root weevils. They need to be tested on blooming red raspberries to determine their effects on honey bees and pollination of the flowers.

OBJECTIVES:

1. Determine whether certain insecticides kill honey bees when applied to blooming red raspberries.
2. Determine whether those insecticides affect honey bee foraging behavior on red raspberries.

PROGRESS:

Sevin XLR appeared to be relatively safe to honey bees on blooming raspberries in 1985. Therefore on May 22, 1986, Sevin XLR Plus was applied at 1 lb. ai/acre in late evening to about 3.25 acres of blooming 'Willamette' and 'Meeker' raspberries at the Southwestern Washington Research Unit. Sevin XLR Plus is very similar to Sevin XLR except that it contains more sticker, which we believed should make it even safer to bees.

A kill of the honey bee field force in the low to moderate range was detected for 1 day at the colonies and more dead bees (about 3 times) died with their tongues fully extended. No obvious reduction in number of bees returning to the colonies was observed. Sevin XLR Plus caused 70% mortality of honey bees 12 hr. after application when bees were confined on treated foliage. Honey bees captured foraging in the plot 15 and 18 hr. after

application had 25 and 0% mortality, respectively. The application reduced the number of foragers in the treated area as compared to the untreated check by 69% (12 hr. after application), 80% (17 hr. after application) and 83% (1 day after application). A 65% reduction between pre-application and 17 hr. after application was observed in the treated area. The colonies did not die and neither the queen nor young adults appeared to be affected by the applications. The largest colony stored two Westerns of honey in three weeks after the application.

Lorsban at 1.5 lb. ai/acre was toxic to honey bees on blooming raspberries and reduced their foraging in 1985 trials. We hoped that reduced rates would have less effect upon the bees so, on July 18, 1986, Lorsban was applied in late evening to blooming 'Amity' raspberries at 0.5 and 1.0 lb. ai/acre.

Both rates of Lorsban caused 100% mortality of honey bees 12 hr. after application when the bees were confined on treated foliage. Honey bees captured foraging in the plots at 13 hr. and 16 hr. after application had 58 and 73% mortality, respectively. The applications reduced the number of honey bee foragers.

The mean time an individual honey bee spent working a flower before the Lorsban application, was 14.0 (6-26) sec. at 5 PM when the temperature was 57° F. Bumble bees spent 7.5 (4-16) sec. Most (62%) honey bees were nectar collectors, while 48% had small pollen loads. Seventy percent of the bumble bees were nectar collectors and 30% had small pollen loads. Fifteen hr. after application, honey bees spent 7.4 and 8.7 sec. per flower in the treated and untreated plots, respectively, when the temperature was 68° F. All bees observed working were "flighty."

We conclude that neither Sevin SLR Plus nor Lorsban may be safely used on blooming raspberries. Both chemicals have potential for use on raspberries in a non-blooming situation.

PROPOSED RESEARCH:

No tests are planned for 1987 unless very promising new chemicals, such as Spur, become available for use on raspberries.

TERMINAL DATE OF BASE PROJECT: March 3, 1991

BUDGET:

	1985	1986	1987
01 Timeslip employees	$1,000	$1,000	No
03 Supplies & services			Request
Bees	500	500	
Miscellaneous	200	200	
04 Travel	300	300	
07 Employee benefits (12% of 01--Social Security, etc)	120	120	
TOTAL	$2,120		$2,120

PROJS/4959/ts

WASHINGTON RED RASPBERRY COMMISSION

PROJECT NO.: New

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. Probably 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.

TERMINATION DATE OF BASE PROJECT:

Project No. 0668, June 30, 1988

DURATION OF THIS PROPOSAL:

This is a one-year study and it will be conducted during 1987 pending the availability of the portable irradiator.

BUDGET:

01	Wages (for timeslip labor)	$ 700.00
03	Supplies and services	100.00
04	Travel to irradiator*	237.00
07	Employee benefits 9% of 01 (social security, etc)	63.00
	TOTAL	$1,100.00

* Travel costs are based on the portable irradiator being located in the Tri Cites area.

PROJECT NO.: New

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

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

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 the genetic integrity and phenotypic stability of these plants remain unanswered. To date, there have been no published reports of field performance trials of micropropagated red raspberry plants.

It has been recently observed that micropropagated red raspberry plants of the selection WSU 738 obtained from different nurseries varied in the amount of fruit crumbliness seen in field trials of these plants. While this condition has been associated with a number of factors including virus infection, it has been suggested that crumbly fruit in the cultivars 'Skeena' and 'Sumner' can be caused by a somatic mutation. 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 commercial raspberry production.

OBJECTIVE: To determine whether clonal lines derived from micropropagation are potential sources of variability in the field performance of micropropagated raspberry plants.

PROPOSED RESEARCH: Plants of the cultivars 'Meeker', 'Skeena', 'Sumner', 'Willamette', and the advanced selection of WSU 738 will be propagated from 10 different micropropagated clonal lines derived from single, disease-free stock plants. Twenty plants per cultivar and clonal line will be established at Vancouver and evaluations of morphology, yield components and fruit integrity will be made in the following two to three seasons. Plants propagated by conventional nursery practices will be used for comparison.

TERMINAL DATE OF BASE PROJECT: Experiment Station Project currently being developed and will be available in the near future.

DURATION OF PROJECT: Two years with a third year possibly required. A number of other experiments are also planned for the proposed planting. Dr. Cameron's program concerned with small fruit development physiology is being initiated in Fall, 1986.

BUDGET:

		Proposed 1987-88
01	Timeslip labor	$ 1,900
03	Supplies and service	829
04	Travel	500
07	Benefits	171
	TOTAL	$ 3,400

SCOTT/rr/ts

PROJECT NO.: New

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 is building a full-scale demonstration irradiator, which will be operated by Battelle Northwest, near the Tri-Cities. It will not be on line until 1989 but a portable irradiation unit will be available in 1987. It may be possible to obtain some time in the portable unit for a pilot study in 1987.

OBJECTIVE:

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

PROPOSED RESEARCH:

Insects that are common contaminants of freshly harvested raspberries will be taken to the irradiator. Details as to whether various levels of radiation and lengths of irradiation time will be tested must be decided when the use of the equipment is granted. After irradiation, the insects will be examined to determine mortality. Insects will also be mixed with fresh raspberries before irradiation if later it is felt this is necessary.

DURATION OF PROJECT:

1 year for pilot study. Funds may be requested in the following 2 years if pilot study is successful.

TERMINAL DATE OF BASE PROJECT: March 31, 1991

BUDGET:

01	Temporary employee	$300
04	Travel to irradiator	273
07	Employee benefits 9% of 01 (Social Security, etc.)	27
		$600

This experiment will be conducted only if use of irradiator can be arranged in 1987.

PROJS/insectrr/ts

PROJECT NO.: New

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

JUSTIFICATION: The twospotted spider mite, Tetranychus urticae Koch, is a sporadic pest of red raspberries. While we have not shown that severe infestations 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.

Spider mites have developed resistance to most of the miticides registered for use on raspberries. Kelthane is still effective in some fields but the mites are resistant to it in many, if not most, fields. Plictran probably still is effective in most raspberry fields but resistance to it is suspected in a few fields. Resistance to it has been reported on other fruit crops. There are few new miticides under development.

There are many predatory insects and mites that help suppress spider mite populations. 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 the effect that pesticides that are 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.

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.

PROPOSED RESEARCH:

Spray programs. Selected growers who are willing to participate in this study will be asked to 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.

Two insecticides commonly used on red raspberries will be tested to determine their effects on spider mite populations and their enemies. Guthion and malathion will be applied at times and rates to simulate the usual use patterns. Leaf samples will be collected periodically during the growing season. The spider mites and predators will be counted. Plots will consist of three 50-ft. rows and treatments will be replicated four times.

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.

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.

TERMINAL DATE OF BASE PROJECT: March 31, 1991

DURATION OF THIS PROPOSAL: 3 years

BUDGET 1987:

01	Temporary Employees	$ 5,200
03	Supplies and Services	200
04	Travel	432
07	Employee Benefits (Social Security, etc.; 9% of 01)	468
	TOTAL	$ 6,300

PROJS/mitesrr/ts

WASHINGTON STATE RED RASPBERRY COMMISSION

PROJECT NO.: New

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 N.W. Marine Drive, 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-tested 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.

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 cannot 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.

From our work with dsRNA we know we can purify virus-specific nucleic acids from raspberries infected with RLSV. This dsRNA will be used as the starting material to develop the cDNA probes. Purified dsRNA will be denatured by heating, or treatment with formamide or methyl mercury. The denatured RNA will then be used as template in reverse transcription reactions using random primers. Second-strand DNA will be made with RNAse H and DNA polymerase and the double-stranded DNA will be tailed then inserted into a bacterial plasmid. This modified plasmid will then be put into a bacterium which will produce a large amount of virus-specific DNA. These manipulations require many different enzymes, radioisotopes to follow the reactions, and nucleic acid binding paper to immobilize fractions of each step along the way to assay the efficiency of each step. Therefore most of the requirements for this project will be in the form of supply money.

During the second year probes will be field tested to ensure that they are useful for their intended purpose.

DURATION OF PROJECT:

1/2 Year one to develop suitable probes and year two to field test the probes.

BUDGET:

01	Temporary employee ... . To purify dsRNA or purify virus	$1000
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	300
07	Benefits 5% of 01	50
	TOTAL	$4350

DISTRIBUTION
of
CALL FOR PROPOSALS
WASHINGTON RED RASPBERRY COMMISSION

Washington Red Raspberry Commission

David Kile, Administrator
Lyle Rader, President
George Ritcher
Ivan Matlock
George Tsugawa
William Boxx
Tyler Clark
Marty Mayberry
Claudia Clark, WA. State Dept. of Agriculture

Washington Red Raspberry Growers Association

Nolan Servoss

Researchers Invited to Present Proposals

Peter Bristow, WWREC - WSU
Thomas M. Sjulin, WWREC - WSU
Robert A. Norton, NWREU - WSU
Carl Shanks, SWRU - WSU
Stott Howard, NWREU - WSU
Sarah Spade - IAREC - WSU
Jim Boch, Washington State Bee Inspector
Alan L. Knight, OSU
Brian A. Croft, OSU
R. H. Converse, USDA-ARS, OSU
John Simpson, WSU
Robert Martin, Ag. Canada

Department Chairs and Other Administrators

Paul Rasmussen, Dept. of Horticulture & Landscape Architecture, WSU
Jack Rogers, Dept. of Plant Pathology, WSU
Paul Catts, Dept. of Entomology, WSU
Dennis Oldenstadt, Assoc. Director, Ag Research Center, WSU
C. J. Weiser, Dept. of Horticulture, OSU
Bruce Eldridge, Dept. of Entomology, OSU
Lin Faulkner, IAREC - WSU
G. W. Bruehl, ARC - WSU
Mary Kohli, WWREC - WSU
Ernest Hopp, WWREC - WSU

Distribution List Continued

Extension Agents and Specialists

Craig McConnell, Whatcom County
Richard Reisinger, Snohomish County
Art Antonelli, WWREC - WSU
Ralph Byther, WWREC - WSU
Richard Carkner, WWREC - WSU
Curt Moulton, King County
William Scheer, Pierce/King Counties
Don Tapio, Thurston County
Charles Brun, Clark County