Colorado Potato Cultivar Management

Data Summary 2009

Samuel Y.C. Essah
Assistant Professor and State Extension Specialist

Colorado State University
Department of Horticulture & Landscape Architecture
San Luis Valley Research Center
Center, Colorado

-Comments Welcome-

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MISSION STATEMENT

The mission of the Colorado Potato Cultivar Management and Physiology Program is to develop cultural management guidelines for newly released and existing potato cultivars, as well as advanced potato selections that have the potential of being released, through field and laboratory research.

Each potato cultivar or advanced selection has its own unique set of cultural management requirements to maximize tuber yield of premium size and grade tubers. Therefore, cultural management practices that maximize the production and quality of individual potato cultivars must be developed.

The best guidelines for fertility practices, irrigation management, plant population management, vine kill management, and other management practices are obtained from field experiments conducted in replicated trials. New cultivars are much more successful when release is accompanied by cultivar specific management guidelines. This information relates growth habit and other plant characteristics to nutrient and other management strategies for yield and quality goals, which are agronomically sound, economically advantageous, and environmentally responsible.

When management guidelines are tailored for individual cultivars it leads to the successful, sustainable, and economic production of the cultivar, which results in the optimization of its genetic potential, while minimizing economic inputs and environmental impact.

Table 1 Effect of nitrogen rate on yield and tuber size distribution of Mesa Russet (CO94035-15RU), 2009

Nitrogen rate (lbN/ac)	Total	< 4oz	> 4oz	> 6oz	4 – 16oz	4 – 10oz	>10oz	10-16oz	6 – 16oz
					Yield (cwt/ac)				
0(56)[1]	440	167	273(62)[2]	135(31)	269	253(58)	20	16	131
60(85)	497	156	342(69)	202(41)	342	306(62)	35	35	202
120(145)	538	124	415(77)	267(50)	405	340(63)	75	65	257
180(205)	548	119	429(78)	264(48)	417	349(64)	71	58	252

[1] Figures in brackets indicate total available N (applied + soil + irrigation water N).
[2] Figures in brackets indicate % of total.

Table 2 Effect of nitrogen rate on tuber quality of Mesa Russet (CO94035-15RU), 2009

Nitrogen rate (lbN/ac)	External Defects[2]	Internal Defects[3]	Specific Gravity
0(56)[1]	0.2	0.5	1.094
60(85)	0.6	0	1.094
120(145)	2.2	1.9	1.091
180(205)	1.1	0	1.093

[1] Figures in brackets indicate total available N (applied + soil + irrigation water N)
[2] Includes growth cracks, knobs and misshapes
[3] Includes hollow heart and brown center.

Table 3 Effect of pre- plant nitrogen application rate on yield and tuber size distribution of Mesa Russet (CO94035-15RU), 2009

Nitrogen rate (lbN/ac)	Total	< 4oz	> 4oz	> 6oz	4 – 16oz	4 – 10oz	>10oz	10-16oz	6 – 16oz
					Yield (cwt/ac)				
0(22)[1]	477	91	386(81)[2]	267(56)	381	308(65)	78	73	263
60(82)	464	74	390(84)	261(56)	373	293(63)	96	80	245
80(102)	416	70	346(83)	243(58)	336	272(65)	73	64	234
100(122)	449	90	359(80)	257(57)	332	269(60)	89	63	230

[1] Figures in brackets indicate total available N (applied + soil + irrigation water N).
[2] Figures in brackets indicate % of total.

Table 4 Effect of pre- plant nitrogen application rate on tuber quality of Mesa Russet (CO94035-15RU), 2009

Nitrogen rate (lbN/ac)	External Defects[2]	Internal Defects[3]	Specific Gravity
0(22)[1]	0.6	1.8	1.091
60(82)	1.4	3.5	1.093
80(102)	0.4	1.6	1.096
100(122)	2.8	3.2	1.095

[1] Figures in brackets indicate total available N (applied + soil + irrigation water N)
[2] Includes growth cracks, knobs and misshapes
[3] Includes hollow heart and brown center.

Table 5 Effect of nitrogen application rate on yield and tuber size distribution of Blazer Russet, 2009

Nitrogen Rate(lb N/ac)	Total	< 4oz	> 4oz	>6oz	4-16oz	4–10oz	10–16oz	6-16oz	>10oz	>16oz
					Yield (cwt/ac)					
0N(56)[1]	420	155	265(63)[2]	116(28)	265	245(58)	20	116	20	0
60N(85)	454	137	317(70)	196(43)	306	276(61)	30	185	41	11
120N(145)	474	135	339(72)	185(39)	336	306(65)	30	181	34	3
180N(205)	478	116	362(76)	228(48)	358	321(67)	37	224	40	4

[1]Figures in blankets indicate total available N (applied + soil + irrigation water N)
[2] Figures in brackets indicate % of total.

Table 6 Effect of nitrogen application rate on tuber quality of Blazer Russet, 2009

Nitrogen Rate (lbN/ac)	% External Defects[2]	% Internal Defects[3]	Specific Gravity
0N(56)[1]	0	0.4	1.104
60N(85)	1.5	0.5	1.100
120N(145)	1.5	1.2	1.098
180N(205)	0	0.7	1.093

[1]Figures in blankets indicate total available N (applied plus soil and irrigation water N)
[2]Includes growth cracks, knobs and misshapes
[3]Includes hollow heart and brown center

Table 7 Effect of nitrogen application rate on yield and tuber size distribution of Blazer Russet (two year average) 2007 and 2009

Nitrogen Rate(lbN/ac)	Total	< 4oz	> 4oz	>6oz	4-16oz	4–10oz	10–16oz	6-16oz	>10oz	>16oz
					Yield (cwt/ac)					
0N(44)[1]	380	108	272	149	269	243	26	146	29	3
60N(89)	409	109	300	177	291	266	25	168	34	9
120N(149)	444	99	345	198	340	297	43	193	49	5
180N(209)	442	106	336	222	334	289	45	220	46	2

[1]Figures in blankets indicate total available N (applied + soil + irrigation water N)

Table 8 Effect of nitrogen application rate on tuber quality of Blazer Russet (two year average) 2007 and 2009

Nitrogen Rate (lbN/ac)	% External Defects[2]	% Internal Defects[3]	Specific Gravity
0N(44)[1]	1.2	1.3	1.097
60N(89)	1.9	0.3	1.093
120N(149)	4.3	2.2	1.091
180N(209)	1.1	0.4	1.088

[1]Figures in blankets indicate total available N (applied plus soil and irrigation water N)
[2]Includes growth cracks, knobs and misshapes
[3]Includes hollow heart and brown center

Influence of potassium fertilizer source and form of application on the performance of Rio Grande Russet

Experimental Procedure

The field study was conducted at the San Luis Valley Research Center, Colorado State University. Treatments were laid out in a randomized complete block design with four replications. Soil samples were taken from the study area and analyzed for soil nutrients before planting (Table 2). Each plot size was four rows wide (34 inches between rows) and 25 ft. long. Treatments included compound fertilizer, N-P-K-S-Zn (80-60-50-25-2.5) applied pre-plant with the potassium (K) source being KCl (potash) or K_2SO_4 (Potassium Sulphate). Also, each of the two compound fertilizers was applied as liquid or dry formulation. A fifth treatment, which was the control, N-P-S-Zn (80-60-25-2.5) contained no K. Rio Grande Russet seed pieces (2.5 to 3.0 oz) were planted 12 inches apart at a depth of 5 inches. Petiole samples were randomly sampled from the fourth leaf beginning from the growing point between July 15 and 28. Samples were dried, fine ground and analyzed for petiole nutrient concentration.

Tubers harvested from each plot were weighed to record total field yield. Tubers from each plot were graded for external and internal defects (Growth cracks, knobs, misshapes, hollow heart and brown center). Tubers were separated into various size distribution groups based on weight (<4 oz, 4-10 oz, 10-16 oz, 4-14oz, and 4-16 oz), and diameter (< 2 in.; 2-4 in.; and > 2 in.). Ten large (10-16 oz) tubers were taken for hollow heart evaluation. Tuber specific gravity was measured using the weight-in-air/weight-in-water method.

Table 9 Soil nutrient analysis before planting

Nitrate-N	P	K	S	Zn	Fe	Mn	Cu
ppm							
4	120	198	7	4.4	18	22	1.3

Results and Discussion

Tuber Yield and Tuber Size Distribution

Potassium source and form of application influenced total tuber yield and tuber size in this study. Potassium sulfate (K_2O) broadcast and worked into the soil pre-plant increased total tuber yield and large marketable (> 6 oz) tuber yield by 15 and 31%, respectively, compared to all other K treatments (Table 3). Dry formulation of K_2SO_4 increased tuber yield in all the size distribution groups compared to liquid formulation of K_2SO_4 (Table 3). For KCl, the form of application (liquid or dry) did not influence tuber yield.

Dry formulation of K_2SO_4 produced more bulky tubers (fig 1) compared to all other K treatments. In this study, soil test K concentration was very high (198 ppm = 455 lb K_2O/A), and therefore K was not limiting. This indicates that Rio Grande Russet can respond positively to dry formulations of K_2SO_4 in soils with high soil available K levels. The fact that residual K was

sufficient in the soil, made the control treatment to produce comparable yields to yields from the dry formulation of potassium sulfate treatments in some tuber size groups (Table 3).

Table 10 Effect of source and form of potassium fertilizer application on yield and tuber size distribution of Rio Grande Russet

Treatment[1]	Total	> 4 oz	4-16 oz	4-10 oz	> 6 oz	6-16 oz
	Yield (cwt/acre)					
Control	542 b	455 b	444 a	354 a	306 b	294 a
K_2O (liq)	480 d	368 d	359 b	304 b	244 c	234 c
K_2O (dry)	576 a	489 a	456 a	358 a	354 a	321 a
KCl (liq)	510 c	412 c	382 b	275 b	295 bc	264 b
KCl (dry)	517 c	400 c	388 b	298 b	273 c	261 bc

[1] K_2O (liq) = Potassium sulfate applied as liquid; K_2O (dry) = Potassium sulfate applied as dry formulation; KCl (liq) = Potassium Chloride applied as liquid; KCl (dry) = Potassium Chloride applied as dry formulation

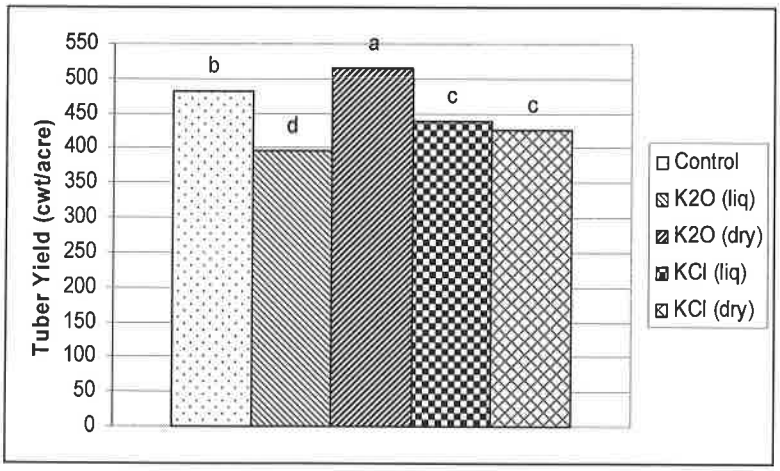

Fig 1 Effect of source and form of potassium fertilizer application on tuber diameter (> 2 inches) of Rio Grande Russet

Table 11 Effect of source and form of potassium (K) on tuber diameter of Rio Grande Russet, 2009

Treatment	< 2 in (dia.)[3]	2 -4 in (dia.)	> 4 in (dia.)	>2in < 10oz	>2in > 10oz
			Yield (cwt/ac)		
Control	61	483	0	382	101
SOP (liquid)[1]	85	395	0	331	64
SOP (dry)	63	509	5	392	122
KCl (liquid)[2]	72	438	0	306	132
KCl (dry)	90	427	0	328	99

[1]SOP = Sulphate of potash
[2] KCl = Potash
[3]dia = Diameter

Tuber Specific Gravity

Tuber specific gravity was significantly high in the dry formulation of potassium sulfate treatment (1.099), compared to all other K treatments (fig 2). Tuber specific gravity of tubers from the potassium sulfate treatments did not differ from those in the control treatment. This indicates that the low specific gravities observed in the other K treatments could be due to increased absorption of K, resulting in high salt concentration in the plant with the subsequent absorption of water by the tubers, which resulted in reduced tuber gravities for those treatments.

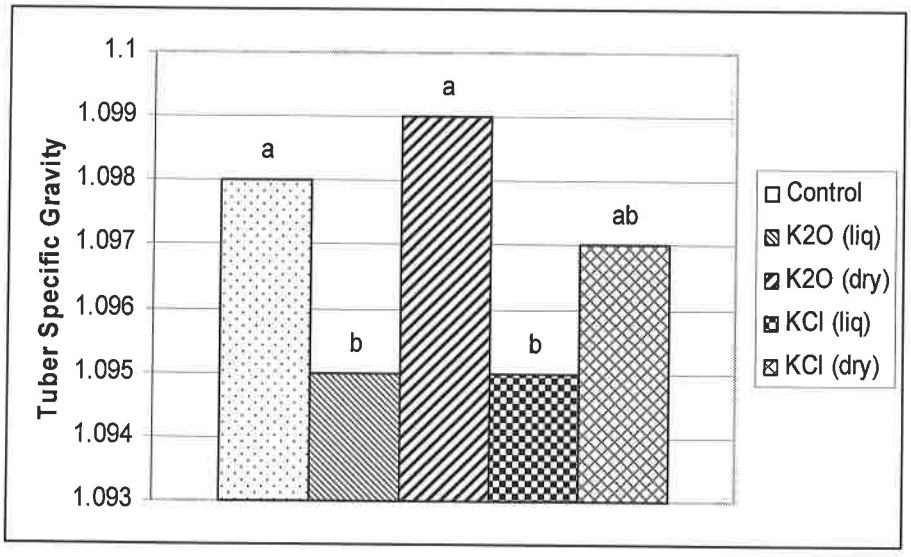

Fig 2 Effect of source and form of potassium fertilizer application on tuber specific gravity of Rio Grande Russet

Table 12 Effect of source and form of potassium (K) application on tuber quality of Rio Grande Russet, 2009

Treatment	External Defects[3]	Internal Defects[4]
Control	0.9	0.5
SOP (liquid)[1]	1.6	0
SOP (dry)	1.4	0.8
KCl (liquid)[2]	5.8	0
KCl (dry)	1.9	0

[1]SOP = Sulphate of potash
[2] KCl = Potash (Potassium Chloride)
[3] Includes growth cracks, knobs and misshapes
[4]Includes hollow heart and brown center.

Summary and Conclusion

Data from this study indicate that the source and form of K fertilizer applied can influence potato tuber yield and quality. Dry formulation of potassium sulfate increased tuber yield and produced more bulky tubers, compared to the use of potash (KCl). Tuber specific gravity was significantly improved by incorporating dry formulation of potassium sulfate in the soil pre-plant. Observations from this study indicate that in soils with high soil test K levels, dry formulations of potassium sulfate can increase potato tuber yield and quality.

Table 13 Effect of compost and nitrogen application rate on yield and tuber size distribution of Rio Grande Russet, 2009

Treatment	Total	< 4oz	> 4oz	> 6oz	4 – 16oz	4 – 10oz	10-16oz	>10oz	6 – 16oz	. >16oz
					Yield (cwt/ac)					
Control[1]	511	112	399(78)[2]	295(56)	390	295(58)	95	104	286	9
1 T/A Full N	568	88	480(85)	376(66)	428	278(49)	150	202	325	52
1 T/A ½ N	576	111	465(81)	343(60)	440	292(51)	148	173	318	25
3 T/A Full N	512	93	419(82)	317(62)	394	250(49)	144	170	291	25
3 T/A ½ N	571	122	449(79)	317(56)	427	300(53)	127	149	295	22
5 T/A Full N	614	138	476(78)	370(61)	453	316(52)	137	160	347	23
5 T/A ½ N	596	129	467(78)	374(63)	447	316(53)	131	151	353	20

[1]Full N = 140 N/ac applied

1T/A = 1 ton of compost applied per acre; 3T/A = 3 ton of compost applied per acre; 5T/A = 5 ton of compost applied per acre

[2] Figures in brackets indicate % of total.

Table 14 Effect of compost and nitrogen application rate on tuber quality of Rio Grande Russet, 2009

Treatment	% Growth cracks	% Knobs	% Misshapes	% Hollow heart	% External[2] Defects	% Internal[3] Defects	Specific Gravity
Control[1]	4.8	0	2.2	1.5	7.0	1.5	1.095
1T/A Full N	1.5	1.5	1.2	0.9	4.3	0.9	1.094
!T/A ½ N	2.4	0.4	1.8	1.2	4.5	1.2	1.095
3T/A Full N	2.0	1.0	2.9	0	5.8	0	1.092
3T/A ½ N	1.9	0	0.8	1.0	2.7	1.0	1.096
5T/A Full N	2.0	0.5	2.3	0	4.7	0	1.091
5T/A ½ N	0.9	0	2.3	0.1	3.2	0.1	1.093

[1]Full N = 140 N/ac applied

1T/A = 1 ton of compost applied per acre; 3T/A = 3 ton of compost applied per acre; 5T/A = 5 ton of compost applied per acre

[2] Includes growth cracks, knobs and misshapes

[3]Includes hollow heart and brown center.

Table 15 Effect of compost and nitrogen application rate on tuber diameter of Rio Grande Russet, 2009

Treatment	<2in (dia.) [2]	2 -4 in (dia.)	> 4 in (dia.)	>2in < 10oz	>2in > 10oz	> 2in (dia.)
	Yield (cwt/ac)					
Control[1]	89	420	0	318	102	420
1T/A Full N	73	493	0	299	194	493
!T/A ½ N	85	489	0	318	171	489
3T/A Full N	78	431	4	267	168	435
3T/A ½ N	89	482	0	339	143	482
5T/A Full N	109	503	0	344	159	503
5T/A ½ N	97	499	0	355	144	499

[1]Full N = 140 lb N/ac applied

1T/A = 1 ton of compost applied per acre; 3T/A = 3 ton of compost applied per acre; 5T/A = 5 ton of compost applied per acre

[2]dia = Diameter

Table 16 Effect of in-season nitrogen application timing on yield and tuber size distribution of Canela Russet, 2009

Application time	Total	< 4oz	> 4oz	>6oz	4-16oz	4–10oz	10–16oz	6-16oz	>10oz	>16oz
	Yield (cwt/ac)									
Early[1]	544	47	497(91)[2]	434(80)	465	266(49)	199	402	231	32
Mid	572	35	537(94)	460(80)	485	314(55)	171	407	223	52
Late	552	34	518(94)	454(82)	447	269(49)	178	382	249	71

[1]Early = nitrogen applied on July 13, 20 and 27;
Mid = nitrogen applied on July 20, 27, and August 3;
Late = nitrogen applied on July 27, Aug 3, and August 10
[2] Figures in brackets indicate % of total.

Table 16 Effect of in-season nitrogen application timing on tuber quality of Canela Russet, 2009

Application time	% External Defects[2]	% Internal Defects[3]	Specific Gravity
Early[1]	0	0	1.112
Mid	0	0	1.108
Late	0.9	0	1.110

[1]Early = nitrogen applied on July 13, 20 and 27;
Mid = nitrogen applied on July 20, 27, and August 3;
Late = nitrogen applied on July 27, Aug 3, and August 10
[2]Includes growth cracks, knobs and misshapes
[3]Includes hollow heart and brown center

Table 17 Effect of in-season nitrogen application timing on yield and tuber size distribution of Canela Russet, (two year average) 2008 and 2009

Application time	Total	< 4oz	> 4oz	>6oz	4-16oz	4–10oz	10–16oz	6-16oz	>10oz	>16oz
	Yield (cwt/ac)									
Early[1]	478	61	417(87)[2]	312(65)	399	280(59)	119	294	137	18
Mid	486	57	429(88)	313(64)	403	304(63)	99	287	125	26
Late	465	63	402(87)	306(66)	366	270(58)	96	270	132	36

[1]Early = nitrogen applied on July 13, 20 and 27;
Mid = nitrogen applied on July 20, 27, and August 3;
Late = nitrogen applied on July 27, Aug 3, and August 10
[2] Figures in brackets indicate % of total.

Table 18 Effect of in-season nitrogen application timing on tuber quality of Canela Russet, (two year average) 2008 and 2009

Application time	% External Defects[2]	% Internal Defects[3]	Specific Gravity
Early[1]	0	0	1.103
Mid	0	0	1.101
Late	0.45	0	1.104

[1]Early = nitrogen applied on July 13, 20 and 27;
Mid = nitrogen applied on July 20, 27, and August 3;
Late = nitrogen applied on July 27, Aug 3, and August 10
[2]Includes growth cracks, knobs and misshapes
[3]Includes hollow heart and brown center

Table 19 Effect of seed spacing on yield and tuber size distribution of Canela Russet, 2009

Seed spacing (inches)	Total	< 4oz	> 4oz	>6oz	4-16oz	4–10oz	10–16oz	6-16oz	>10oz	>16oz
	Yield (cwt/ac)									
10	436	55	381(87) [1]	257(59)	374	316(73)	58	249	66	7
12	420	44	376(90)	287(68)	355	283(67)	72	266	92	21
14	435	40	395(91)	313(72)	386	282(65)	104	304	113	9

[1] Figures in brackets indicate % of total.

Table 20 Effect of seed spacing on tuber quality of Canela Russet, 2009

Seed spacing (inches)	% External Defects[1]	% Internal Defects[2]	Specific Gravity
10	0	0	1.106
12	0	0	1.108
14	0	0	1.105

[1]Includes growth cracks, knobs and misshapes
[2]Includes hollow heart and brown center

Table 21 Effect of seed spacing on yield and tuber size distribution of CO95172-3RU, 2009

Seed spacing (inches)	Total	< 4oz	> 4oz	>6oz	4-16oz	4–10oz	10–16oz	6-16oz	>10oz	>16oz
					Yield (cwt/ac)					
10	514	175	339(66) [1]	173(34)	339	302(59)	37	173	37	0
12	542	154	388(72)	205(38)	384	359(66)	25	201	28	4
14	513	156	357(70)	198(39)	357	313(61)	44	198	44	0

[1] Figures in brackets indicate % of total.

Table 22 Effect of seed spacing on tuber quality of CO95172-3RU, 2009

Seed spacing (inches)	% External Defects[1]	% Internal Defects[2]	Specific Gravity
10	0.2	0	1.093
12	0.6	0	1.094
14	0.7	0	1.093

[1]Includes growth cracks, knobs and misshapes
[2]Includes hollow heart and brown center

Table 23 Effect of seed spacing on yield and tuber size distribution of CO95172-3RU(two year average),2008 and 2009

Seed spacing (inches)	Total	< 4oz	> 4oz	4-16oz	4–10oz	10–16oz	6-12oz	12-16oz	>16oz
					Yield (cwt/ac)				
10	467	52	282(60)[1]	282	261(56)	21	127	4	0
12	474	53	313(66)	311	287(61)	24	149	6	2
14	450	50	302(67)	302	273(61)	29	141	7	0

[1] Figures in brackets indicate % of total.

Table 24 Effect of seed spacing on tuber quality of CO95172-3RU (two year average), 2008 and 2009

Seed spacing (inches)	% External Defects[1]	% Internal Defects[2]	Specific Gravity
10	0.7	0	1.089
12	1.0	0	1.090
14	1.1	0	1.091

[1]Includes growth cracks, knobs and misshapes
[2]Includes hollow heart and brown center

Table 25 Response of Russet Norkotah (sel.3) to different green manure cover crops, 2009

Treatment Cover crop	Total	< 4oz	> 4oz	>6oz	4-16oz	4–10oz	10–16oz	4-12oz	6-12oz	6-14oz	6-16oz	12-16oz	>10oz	>16oz
	Yield (cwt/ac)													
Fallow	493	65	428	346	407	288	119	347	265	298	325	60	140	21
Barley	498	55	443	359	415	269	146	342	258	300	331	73	173	28
Barley +Comp	411	63	348	290	307	207	100	267	209	234	249	39	141	41
Sunflower	512	67	445	346	431	301	130	367	268	308	332	65	144	14
Sordan Hay	484	54	430	333	382	255	127	307	210	254	285	75	175	48
Sordan 79	456	72	384	298	369	274	95	329	242	269	282	40	111	15
Peas	467	47	420	353	378	237	141	314	246	288	311	65	184	42
Mustard	466	63	403	323	369	275	94	297	217	254	289	72	128	34
Radish	462	61	401	306	367	252	115	309	214	249	272	58	149	34
Sordan Mix	496	61	435	329	397	319	78	356	250	276	291	40	116	38
Winter Wheat	506	58	448	351	402	308	94	348	251	288	305	54	140	46

Table 26 Effect of different green manure cover crops on tuber quality of Russet Norkotah (sel.3), 2009

Treatment Cover crop	% External Defects[1]	% Internal Defects[2]	% Rots
Fallow	4.2	11.1	9.6
Barley	6.6	15.1	9.3
Barley +Comp	6.0	12.4	19.9
Sunflower	4.6	0	0.5
Sordan Hay	3.8	2.9	4.7
Sordan 79	2.9	2.3	4.3
Peas	5.7	9.4	11.3
Mustard	2.9	1.6	3.7
Radish	9.1	2.7	4.9
Sordan Mix	3.9	3.0	3.4
Winter Wheat	2.6	10.0	7.2

[1]Includes growth cracks, knobs and misshapes
[2]Includes hollow heart and brown center

Table 27 Effect of compost tea, fungicide application, and nitrogen application rate on yield and tuber size distribution of Russet Norkotah (sel.8), 2009

Treatment	Total	< 4oz	> 4oz	>6oz	4-16oz	4–10oz	10–16oz	6-16oz	>10oz	>16oz
	Yield (cwt/ac)									
80N[1]	518	90	428(83)[2]	303(59)	417	336(65)	81	291	92	11
120N	530	92	438(83)	326(62)	425	329(62)	96	313	109	13
80N-CT	557	98	459(82)	348(63)	433	333(60)	100	322	126	26
120N-CT	524	72	452(86)	313(60)	452	370(71)	82	313	82	0
80N-F	526	65	461(88)	326(62)	443	360(68)	83	308	102	18
120N-F	520	72	448(86)	331(64)	442	317(61)	125	325	131	6

[1]N= Nitrogen rate (lb N/ac) CT = Compost Tea Applied F = Fungicide Applied
[2] Figures in brackets indicate % of total.

Table 28 Effect of compost tea, fungicide application, and nitrogen application rate on tuber quality of Russet Norkotah (sel.8), 2009

Treatment	% External Defects[2]	% Internal Defects[3]	Specific Gravity
80N[1]	0.3	0.4	1.086
120N	0.4	0.6	1.080
80N-CT	0.8	0	1.086
120N-CT	1.4	0	1.080
80N-F	1.6	0	1.087
120N-F	3.9	0	1.082

[1]N= Nitrogen rate (lb N/ac) CT = Compost Tea Applied F = Fungicide Applied
[2]Includes growth cracks, knobs and misshapes
[3]Includes hollow heart and brown center

Table 29 Effect of compost tea, fungicide application, and nitrogen application rate on yield and tuber size distribution of Russet Norkotah (sel.8), (two year average) 2008 and 2009.

Treatment	Total	< 4oz	> 4oz	4-16oz	4–10oz	10–16oz	4-12oz	6-12oz	6-14oz	6-16oz	12-16oz	>16oz
	Yield (cwt/ac)											
80N[1]	466	79	387	379	301	78	356	248	270	272	25	8
120N	466	70	396	385	290	95	350	252	282	287	35	11
80N-CT	453	80	373	358	287	71	324	227	253	262	34	15
120N-CT	456	62	394	392	320	72	362	246	261	276	30	2
80N-F	475	64	411	395	313	82	361	250	273	285	35	16
120N-F	451	61	390	385	290	95	355	251	275	281	31	5

[1]N= Nitrogen rate (lb N/ac) CT = Compost Tea Applied F = Fungicide Applied

Table 30 Effect of compost tea, fungicide application, and nitrogen application rate on tuber quality of Russet Norkotah (sel.8), (two year average) 2008 and 2009.

Treatment	% External Defects[2]	% Internal Defects[3]	Specific Gravity
80N[1]	2.7	0.2	1.081
120N	1.5	0.3	1.077
80N-CT	2.2	0.8	1.080
120N-CT	1.9	0.4	1.077
80N-F	1.2	0	1.082
120N-F	3.1	0.3	1.079

[1]N= Nitrogen rate (lb N/ac) CT = Compost Tea Applied F = Fungicide Applied
[2]Includes growth cracks, knobs and misshapes
[3]Includes hollow heart and brown center

Table 31 Effect of compost tea, fungicide application, and nitrogen application rate on yield and tuber size distribution of Russet Norkotah (sel.8), (three year average) 2007, 2008 and 2009.

Treatment	Total	< 4oz	> 4oz	4-16oz	4–10oz	10–16oz	4-12oz	6-12oz	12-16oz	>16oz
					Yield (cwt/ac)					
80N[1]	448	78	370	362	284	78	332	229	31	8
120N	446	69	377	364	274	90	330	238	34	13
80N-CT	449	78	371	356	280	76	317	222	39	15
120N-CT	439	58	381	379	304	75	346	237	33	2
80N-F	451	60	391	376	294	82	341	238	35	15
120N-F	451	60	391	380	277	104	339	241	41	11

[1]N= Nitrogen rate (lb N/ac) CT = Compost Tea Applied F = Fungicide Applied

Table 32 Effect of compost tea, fungicide application, and nitrogen application rate on tuber quality of Russet Norkotah (sel.8), (three year average) 2007, 2008 and 2009.

Treatment	% External Defects[2]	% Internal Defects[3]	Specific Gravity
80N[1]	2.0	0.2	1.082
120N	1.2	0.8	1.079
80N-CT	2.0	1.1	1.083
120N-CT	1.8	0.2	1.079
80N-F	1.5	0.2	1.084
120N-F	3.2	0.6	1.081

[1]N= Nitrogen rate (lb N/ac) CT = Compost Tea Applied F = Fungicide Applied
[2]Includes growth cracks, knobs and misshapes
[3]Includes hollow heart and brown center

Table 33 Effect of compost tea, fungicide application, and nitrogen application rate on yield and tuber size distribution of Russet Nuggets, 2009

Treatment	Total	< 4oz	> 4oz	>6oz	4-16oz	4–10oz	10–16oz	6-16oz	>10oz	>16oz
	Yield (cwt/ac)									
80N[1]	420	109	311(74)[2]	188(45)	306	257(61)	49	183	54	5
120N	450	106	344(76)	206(46)	340	284(63)	56	202	60	4
80N-CT	418	113	305(73)	160(38)	305	278(67)	27	160	27	0
120N-CT	398	126	272(68)	132(33)	272	259(65)	13	132	14	0
80N-F	397	108	289(73)	155(39)	285	249(63)	36	151	40	4
120N-F	469	122	347(74)	178(38)	337	310(66)	27	168	37	10

[1]N= Nitrogen rate (lb N/ac) CT = Compost Tea Applied F = Fungicide Applied
[2] Figures in brackets indicate % of total.

Table 34 Effect of compost tea, fungicide application, and nitrogen application rate on tuber quality of Russet Nuggets, 2009

Treatment	% External Defects[2]	% Internal Defects[3]	Specific Gravity
80N[1]	0.6	0.5	1.106
120N	1.1	0	1.103
80N-CT	0.9	0	1.106
120N-CT	1.0	0	1.102
80N-F	1.2	0	1.107
120N-F	0.2	0	1.103

[1]N= Nitrogen rate (lb N/ac) CT = Compost Tea Applied F = Fungicide Applied
[2]Includes growth cracks, knobs and misshapes
[3]Includes hollow heart and brown center

Table 35 Effect of compost tea, fungicide application, and nitrogen application rate on yield and tuber size distribution of Russet Nugget (two year average) 2008 and 2009.

Treatment	Total	< 4oz	> 4oz	4-16oz	4–10oz	10–16oz	4-12oz	6-12oz	6-14oz	6-16oz	12-16oz	>16oz
	Yield (cwt/ac)											
80N[1]	392	121	271	269	241	28	263	137	143	143	6	2
120N	410	102	308	306	259	47	293	160	167	173	14	2
80N-CT	401	111	290	288	266	22	278	131	132	141	11	2
120N-CT	399	120	279	279	270	9	276	120	122	124	4	0
80N-F	370	110	260	258	231	27	241	110	120	127	17	2
120N-F	429	130	299	294	277	17	286	128	132	136	8	5

[1]N= Nitrogen rate (lb N/ac) CT = Compost Tea Applied F = Fungicide Applied

Table 36 Effect of compost tea, fungicide application, and nitrogen application rate on tuber quality of Russet Nugget, (two year average) 2008 and 2009.

Treatment	% External Defects[2]	% Internal Defects[3]	Specific Gravity
80N[1]	0.7	0.3	1.102
120N	1.1	0	1.100
80N-CT	1.2	0	1.104
120N-CT	1.0	0	1.100
80N-F	1.6	0	1.105
120N-F	0.6	0	1.100

[1]N= Nitrogen rate (lb N/ac) CT = Compost Tea Applied F = Fungicide Applied
[2]Includes growth cracks, knobs and misshapes
[3]Includes hollow heart and brown center

Table 37 Effect of compost tea, fungicide application, and nitrogen application rate on yield and tuber size distribution of Russet Nugget, (three year average) 2007, 2008 and 2009.

Treatment	Total	< 4oz	> 4oz	4-16oz	4–10oz	10–16oz	4-12oz	6-12oz	12-16oz	>16oz
					Yield (cwt/ac)					
80N[1]	373	126	247	244	216	28	237	124	7	3
120N	388	115	273	270	230	40	257	136	14	3
80N-CT	378	118	260	259	240	19	250	115	10	1
120N-CT	367	124	243	243	233	10	240	106	4	0
80N-F	360	118	242	240	215	25	224	98	16	2
120N-F	413	132	281	276	255	21	268	123	9	5

[1]N= Nitrogen rate (lb N/ac) CT = Compost Tea Applied F = Fungicide Applied

Table 38 Effect of compost tea, fungicide application, and nitrogen application rate on tuber quality of Russet Nugget, (three year average) 2007, 2008 and 2009.

Treatment	% External Defects[2]	% Internal Defects[3]	Specific Gravity
80N[1]	1.1	0.3	1.100
120N	1.0	0	1.098
80N-CT	0.9	0	1.101
120N-CT	1.5	0	1.098
80N-F	1.4	0	1.103
120N-F	0.6	0	1.099

[1]N= Nitrogen rate (lb N/ac) CT = Compost Tea Applied F = Fungicide Applied
[2]Includes growth cracks, knobs and misshapes
[3]Includes hollow heart and brown center

Table 39 Effect of calcium application timing on yield and tuber size distribution of Mountain Rose, 2009

Treatment[1]	Total	< 4oz	> 4oz	>6oz	4-16oz	4–10oz	10–16oz	6-16oz	>10oz	>16oz
	Yield (cwt/ac)									
Control	618	207	411(67)[2]	233(38)	407	346(56)	61	229	65	4
T1	773	255	518(67)	305(40)	512	442(57)	70	299	75	6
T2	649	222	427(66)	245(38)	414	369(57)	45	232	58	13
T3	688	221	467(68)	270(39)	447	411(60)	36	250	56	20

[1] T1 = 30 lb/ac Ca applied on 7/22
T2 = 15 lb/ac Ca applied on 7/22 and 15 lb/ac Ca applied on 7/29
T3 = 10 lb/ac Ca applied on 7/22, 10 lb/ac Ca applied on 7/29, and 10 lb/ac Ca applied on 8/5
[2]Figures in brackets indicate % of total

Table 40 Effect of calcium application timing on tuber quality of Mountain Rose, 2009

Treatment[1]	% External Defects[2]	% Internal Defects[3]	Specific Gravity
Control	6.6	0	1.094
T1	7.1	0	1.094
T2	4.9	0	1.092
T3	5.0	0	1.090

[1] T1 = 30 lb/ac Ca applied on 7/22
T2 = 15 lb/ac Ca applied on 7/22 and 15 lb/ac Ca applied on 7/29
T3 = 10 lb/ac Ca applied on 7/22, 10 lb/ac Ca applied on 7/29, and 10 lb/ac Ca applied on 8/5
[2]Includes growth cracks, knobs and misshapes
[3]Includes hollow heart and brown center

Table 41 Effect of calcium application timing on yield and tuber size distribution of Purple Majesty, 2009

Treatment[1]	Total	< 4oz	> 4oz	>6oz	4-16oz	4–10oz	10–16oz	6-16oz	>10oz	>16oz
	Yield (cwt/ac)									
Control	674	269	405(60)[2]	223(33)	405	328(49)	77	223	77	0
T1	652	250	402(62)	253(39)	361	304(47)	57	211	98	41
T2	769	264	505(66)	316(41)	497	411(54)	86	308	94	8
T3	672	270	402(60)	239(36)	389	329(49)	60	226	73	13

[1] T1 = 30 lb/ac Ca applied on 7/22
T2 = 15 lb/ac Ca applied on 7/22 and 15 lb/ac Ca applied on 7/29
T3 = 10 lb/ac Ca applied on 7/22, 10 lb/ac Ca applied on 7/29, and 10 lb/ac Ca applied on 8/5
[2]Figures in brackets indicate % of total

Table 42 Effect of calcium application timing on tuber quality of Purple Majesty, 2009

Treatment[1]	% External Defects[2]	% Internal Defects[3]	Specific Gravity
Control	3.6	0	1.084
T1	6.0	0	1.090
T2	1.4	0	1.085
T3	4.2	0	1.089

[1] T1 = 30 lb/ac Ca applied on 7/22
T2 = 15 lb/ac Ca applied on 7/22 and 15 lb/ac Ca applied on 7/29
T3 = 10 lb/ac Ca applied on 7/22, 10 lb/ac Ca applied on 7/29, and 10 lb/ac Ca applied on 8/5
[2]Includes growth cracks, knobs and misshapes
[3]Includes hollow heart and brown center

Table 43 Effect of calcium application timing on yield and tuber size distribution of Colorado Rose, 2009

Treatment[1]	Total	< 4oz	> 4oz	>6oz	4-16oz	4–10oz	10–16oz	6-16oz	>10oz	>16oz
					Yield (cwt/ac)					
Control	823	165	658(80)[2]	499(61)	632	486(59)	146	473	172	26
T1	771	176	595(77)	440(57)	556	411(53)	145	401	184	39
T2	828	206	622(75)	453(55)	600	455(55)	145	431	167	22
T3	842	150	692(82)	514(61)	657	478(57)	179	479	214	35

[1] T1 = 30 lb/ac Ca applied on 7/22
T2 = 15 lb/ac Ca applied on 7/22 and 15 lb/ac Ca applied on 7/29
T3 = 10 lb/ac Ca applied on 7/22, 10 lb/ac Ca applied on 7/29, and 10 lb/ac Ca applied on 8/5
[2]Figures in brackets indicate % of total

Table 44 Effect of calcium application timing on tuber quality of Colorado Rose, 2009

Treatment[1]	% External Defects[2]	% Internal Defects[3]	Specific Gravity
Control	1.4	0	1.091
T1	2.2	0	1.088
T2	0.7	0	1.087
T3	0.7	0	1.091

[1] T1 = 30 lb/ac Ca applied on 7/22
T2 = 15 lb/ac Ca applied on 7/22 and 15 lb/ac Ca applied on 7/29
T3 = 10 lb/ac Ca applied on 7/22, 10 lb/ac Ca applied on 7/29, and 10 lb/ac Ca applied on 8/5
[2]Includes growth cracks, knobs and misshapes
[3]Includes hollow heart and brown center

Table 45 Effect of seed spacing and nitrogen rate interaction on tuber length of CO00405-1R (fingerling), 2009

Seed spacing / Nitrogen rate (in/lbs per ac)	Total	< 2"	2 - 4"	> 4"
		Yield (cwt/ac)		
4" 0N (25) [1]	377	110	266	1
4" 60N (85)	468	103	359	6
4" 80N (105)	488	88	382	17
4" 100N (125)	530	89	412	29
8" 0N (25)	376	62	297	17
8" 60N (85)	418	78	313	27
8" 80N (105)	449	79	345	25
8" 100N (125)	473	65	364	44
12" 0N (25)	357	46	291	20
12" 60N (85)	415	53	339	23
12" 80N (105)	425	55	342	28
12" 100N (125)	457	51	357	49

[1]Figures in blankets indicate total available N (applied + soil + irrigation water N)

Table 46 Effects of nitrogen rate averaged over seed spacing on tuber length of CO00405-1R (fingerling), 2009

Nitrogen rate (lb/ac)	< 2"	2 – 4"	> 4"
	Yield (cwt/ac)		
0N (25) [1]	72	285	13
60N (85)	78	337	19
80N (105)	74	356	23
100N (125)	68	378	41

[1]Figures in blankets indicate total available N (applied + soil + irrigation water N)

Table 47 Effects of seed spacing averaged over nitrogen rate on tuber length of CO00405-1R (fingerling), 2009

Seed spacing (inches)	< 2"	2 – 4"	> 4"
	Yield (cwt/ac)		
4"	97	355	14
8"	71	330	28
12"	51	332	30

Table 48 Effect of seed spacing and nitrogen rate interaction on tuber diameter of CO00405-1R (fingerling), 2009

Seed spacing/ Nitrogen rate (in/lbs per ac)	< 1" dia[2]	1- 2" dia	> 2" dia
		Yield (cwt/ac)	
4" 0N (25) [1]	47	328	2
4" 60N (85)	47	419	3
4" 80N (105)	41	437	10
4" 100N (125)	42	470	19
8" 0N (25)	23	346	8
8" 60N (85)	40	367	10
8" 80N (105)	34	402	14
8" 100N (125)	28	427	19
12" 0N (25)	24	329	4
12" 60N (85)	29	380	7
12" 80N (105)	25	396	4
12" 100N (125)	27	409	21

[1]Figures in blankets indicate total available N (applied + soil + irrigation water N)
[2]dia = diameter

Table 49 Effect of nitrogen rate averaged over seed spacing on tuber diameter of CO00405-1R (fingerling), 2009

Nitrogen rate (lb/ac)	< 1" dia[2]	1- 2" dia	> 2" dia
		Yield (cwt/ac)	
0N (25)[1]	31	334	5
60N (85)	38	388	7
80N (105)	33	411	9
100N (125)	32	435	20

[1]Figures in blankets indicate total available N (applied + soil + irrigation water N)
[2]dia = diameter

Table 50 Effect of seed spacing averaged over nitrogen rate on tuber diameter of CO00405-1R (fingerling), 2009

Seed spacing (inches)	< 1" dia[1]	1 – 2" dia	> 2" dia
		Yield (cwt/ac)	
4"	97	355	14
8"	71	330	28
12"	51	332	30

[1]dia = diameter

Table 51 Effect of seed spacing and nitrogen rate interaction on tuber quality of CO00405-1R (fingerling), 2009

Seed spacing Nitrogen rate / (in/lbs per ac)	External Defects[2]	Internal Defects[3]	Specific Gravity
4" 0N (25) [1]	0	0	1.097
4" 60N (85)	0	0	1.096
4" 80N (105)	0	0	1.090
4" 100N (125)	0	0	1.087
8" 0N (25)	0	0	1.091
8" 60N (85)	0	0	1.093
8" 80N (105)	0	0	1.089
8" 100N (125)	0	0	1.088
12" 0N (25)	0	0	1.094
12" 60N (85)	0	0	1.092
12" 80N (105)	0	0	1.088
12" 100N (125)	0	0	1.086

[1]Figures in blankets indicate total available N (applied + soil + irrigation water N)
[2] Includes growth cracks and knobs
[3]Includes hollow heart and brown center

Table 52 Effect of seed spacing and nitrogen rate interaction on tuber length of CO03094-5R (fingerling), 2009

Seed spacing/ Nitrogen rate (in/lbs per ac)	Total	< 2"	2 - 4"	> 4"
		Yield (cwt/ac)		
4" 0N (25)[1]	503	37	371	95
4" 60N (85)	503	40	353	110
4" 80N (105)	480	26	303	151
4" 100N (125)	565	29	368	168
8" 0N (25)	534	27	356	151
8" 60N (85)	539	26	369	144
8" 80N (105)	510	23	330	157
8" 100N (125)	523	22	339	162
12" 0N (25)	273	21	121	131
12" 60N (85)	319	21	159	139
12" 80N (105)	339	19	163	157
12" 100N (125)	363	18	152	193

[1]Figures in blankets indicate total available N (applied + soil + irrigation water N)

Table 53 Effect of nitrogen rate averaged over seed spacing on tuber length of CO03094-5R (fingerling), 2009

Nitrogen rate (lb/ac)	< 2"	2 – 4"	> 4"
	Yield (cwt/ac)		
0N (25)[1]	28	283	126
60N (85)	29	294	131
80N (105)	23	265	155
100N (125)	23	286	174

[1]Figures in blankets indicate total available N (applied + soil + irrigation water N)

Table 54 Effect of seed spacing averaged over nitrogen rate on tuber length of CO03094-5R (fingerling), 2009

Seed spacing (inches)	< 2"	2 – 4"	> 4"
	Yield (cwt/ac)		
4"	33	349	131
8"	24	349	154
12"	20	149	155

Table 55 Effect of seed spacing and nitrogen rate interaction on tuber diameter of CO03094-5R (fingerling), 2009

Seed spacing/ Nitrogen rate (in/lbs per ac)	< 1" dia[2]	1- 2" dia	> 2" dia
		Yield (cwt/ac)	
4" 0N (25)[1]	49	467	10
4" 60N (85)	51	461	6
4" 80N (105)	35	456	19
4" 100N (125)	38	531	24
8" 0N (25)	40	487	7
8" 60N (85)	32	499	7
8" 80N (105)	32	468	10
8" 100N (125)	33	483	7
12" 0N (25)	32	391	4
12" 60N (85)	29	439	3
12" 80N (105)	28	481	1
12" 100N (125)	25	493	8

[1]Figures in blankets indicate total available N (applied + soil + irrigation water N)
[2]dia = diameter

Table 56 Effects of nitrogen rate averaged over seed spacing on tuber diameter of CO03094-5R (fingerling), 2009

Nitrogen rate (lb/ac)	< 1" dia[2]	1- 2" dia	> 2" dia
	Yield (cwt/ac)		
0N (25)[1]	40	448	7
60N (85)	37	467	6
80N (105)	31	468	10
100N (125)	32	502	13

[1]Figures in blankets indicate total available N (applied + soil + irrigation water N)
[2]dia = diameter

Table 57 Effects of seed spacing averaged over nitrogen rate on tuber diameter of CO03094-5R (fingerling), 2009

Seed spacing (inches)	< 1" dia[1]	1 – 2" dia	> 2" dia
	Yield (cwt/ac)		
4"	43	479	15
8"	34	484	8
12"	29	451	4

[1]dia = diameter

Table 58 Effect of seed spacing and nitrogen rate interaction on tuber quality of CO03094-5R (fingerling), 2009

Seed spacing Nitrogen rate / (in/lbs per ac)	External Defects[2]	Internal Defects[3]	Specific Gravity
4" 0N (25)[1]	0.4	0	1.084
4" 60N (85)	0.8	0	1.083
4" 80N (105)	4.2	0	1.082
4" 100N (125)	0	0	1.082
8" 0N (25)	0	0	1.081
8" 60N (85)	0	0	1.081
8" 80N (105)	2.7	0	1.080
8" 100N (125)	0.4	0	1.081
12" 0N (25)	0	0	1.079
12" 60N (85)	0	0	1.081
12" 80N (105)	0	0	1.080
12" 100N (125)	0	0	1.079

[1]Figures in blankets indicate total available N (applied + soil + irrigation water N)
[2] Includes growth cracks and knobs
[3]Includes hollow heart and brown center

Table 59 Effect of seed spacing and nitrogen rate interaction on tuber length of Banana (fingerling), 2009

Seed spacing/ Nitrogen rate (in/lbs per ac)	Total	< 2"	2 - 4"	> 4"
		Yield (cwt/ac)		
4" 0N (25)[1]	406	107	280	19
4" 60N (85)	496	98	351	47
4" 80N (105)	517	90	362	65
4" 100N (125)	528	78	388	62
8" 0N (25)	361	66	269	26
8" 60N (85)	459	50	312	97
8" 80N (105)	413	46	293	74
8" 100N (125)	448	49	309	90
12" 0N (25)	392	53	284	55
12" 60N (85)	419	52	299	68
12" 80N (105)	409	45	276	88
12" 100N (125)	453	44	304	105

[1]Figures in blankets indicate total available N (applied + soil + irrigation water N)

Table 60 Effect of nitrogen rate averaged over seed spacing on tuber length of Banana (fingerling), 2009

Nitrogen rate (lb/ac)	< 2"	2 – 4"	> 4"
	Yield (cwt/ac)		
0N (25)[1]	75	278	34
60N (85)	67	321	71
80N (105)	60	310	76
100N (125)	57	334	86

[1]Figures in blankets indicate total available N (applied + soil + irrigation water N)

Table 61 Effect of seed spacing averaged over nitrogen rate on tuber length of Banana (fingerling), 2009

Seed spacing (inches)	< 2"	2 – 4"	> 4"
		Yield (cwt/ac)	
4"	93	345	48
8"	53	296	72
12"	49	291	79

Table 62 Effect of seed spacing and nitrogen rate interaction on tuber diameter of Banana (fingerling), 2009

Seed spacing/ Nitrogen rate (in/lbs per ac)	< 1" dia[2]	1- 2" dia	> 2" dia
		Yield (cwt/ac)	
4" 0N (25)[1]	107	294	5
4" 60N (85)	98	390	8
4" 80N (105)	104	397	16
4" 100N (125)	97	419	12
8" 0N (25)	76	284	0
8" 60N (85)	77	376	7
8" 80N (105)	84	328	2
8" 100N (125)	71	370	8
12" 0N (25)	62	329	2
12" 60N (85)	68	351	1
12" 80N (105)	73	334	2
12" 100N (125)	75	378	0

[1]Figures in blankets indicate total available N (applied + soil + irrigation water N)
[2]dia = diameter

Table 63 Effect of nitrogen rate averaged over seed spacing on tuber diameter of Banana (fingerling), 2009

Nitrogen rate (lb/ac)	< 1" dia[2]	1- 2" dia	> 2" dia
	Yield (cwt/ac)		
0N (25)[1]	81	303	2
60N (85)	81	372	5
80N (105)	87	353	6
100N (125)	81	389	7

[1]Figures in blankets indicate total available N (applied + soil + irrigation water N)
[2]dia = diameter

Table 64 Effects of seed spacing averaged over nitrogen rate on tuber diameter of Banana (fingerling), 2009

Seed spacing (inches)	< 1" dia[1]	1 – 2" dia	> 2" dia
	Yield (cwt/ac)		
4"	101	271	10
8"	77	339	4
12"	70	348	1

[1]dia = diameter

Table 65 Effect of seed spacing and nitrogen rate interaction on tuber quality of Banana (fingerling), 2009

Seed spacing/ Nitrogen rate (in/lbs per ac)	External Defects[2]	Internal Defects[3]	Specific Gravity
4" 0N (25)[1]	0	0	1.095
4" 60N (85)	0	0	1.097
4" 80N (105)	1	0	1.096
4" 100N (125)	0	0	1.097
8" 0N (25)	0.8	0	1.094
8" 60N (85)	0	0	1.094
8" 80N (105)	2.7	0	1.095
8" 100N (125)	0	0	1.097
12" 0N (25)	0	0	1.093
12" 60N (85)	0	0	1.095
12" 80N (105)	0.8	0	1.094
12" 100N (125)	0	0	1.093

[1]Figures in blankets indicate total available N (applied + soil + irrigation water N)
[2] Includes growth cracks and knobs
[3]Includes hollow heart and brown center