Dust Mitigation and Monitoring Research for Williston Reservoir Beachesin British Columbia

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Williston Reservoir in northern British Columbia was created when BC Hydro constructed Bennett Dam on the Peace River in 1968 to generate hydroelectric power. Williston Reservoir is the largest body of freshwater in British Columbia with a surface area of 438,000 acres and a shoreline of 1100 miles. The First Nation Tsay Keh band was forced to relocate to the north end of the reservoir as a result of the water impoundment. Each year the draw down of the Williston Reservoir for the production of hydroelectric power results in the exposure of approximately 25,000 acres of wide flat beaches with surfaces comprised predominantly of fine-grained sediments. On exposure in the spring, these sediments are prone to deflation by wind, resulting in large dust storms. With funding and coordination by BC Hydro, we initiated a 3-year study to determine the effectiveness of roughening the beach with tillage by lifting silt and clay from below the soil surface on dust mitigation by trapping saltating soil particles. The objective was to (i) evaluate the effectiveness of two tillage practices to mitigate dust from beaches, and (ii) conduct regional dust monitoring at six sites surrounding Williston Reservoir. The tillage experiment in 2008 was located on Omineca Beach and covered 185 acres. Treatments were: (i) tillage with twisted-point chisel with shanks spaced 1 m apart, (ii) tillage with a lister plow with lister blades spaced 1.3 m apart, and (iii) a check. Particulate emissions were measured using an array of 360 Big Spring Number Eight (BSNE) samplers and numerous aerosol monitors. Each of the six regional monitoring sites has a wide array of apparatus to monitor $PM_{2.5}$, PM_{10}, and total particulates on a 24-hour basis. Data from 2008 indicate that roughening the beach with tillage effectively reduced sand transport during wind events by reducing the near surface wind speed because of the increased surface roughness and by the trapping of sediment in the furrows (Fig. 1). These, and other experiments, are continuing in 2009 and 2010.

Fig. 1. Trapped sediment on the upwind edge of a twisted-point chisel plot. Trapping of sand reduces the abrasive action of the saltating sand that ejects dust into the air stream.

Agronomics and Economics of No-till Facultative Wheat at Ralston, WA, USA

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Winter wheat/dust-mulch summer fallow (WW/SF) experiences serious wind erosion in the low precipitation zone (<300 mm annual precipitation) of the Pacific Northwest (PNW). One proposed alternative to WW/SF is no-till facultative wheat (FW). Generally, FW's have less cold tolerance, a shorter but distinct period required for vernalization, and start growing and initiate flowering earlier compared with true WW's. This study compares agronomic, economic, and soil moisture components of FW/chemical fallow (FW/ChF), FW/spring wheat (FW/SW), and WW/reduced tillage SF (WW/RSF) rotations near Ralston, Washington. Over the 2003-2006 (harvest years) study period, which averaged about 300 mm annual ppt, spring soil water content (SWC) was greater for ChF compared with RSF at all depths except 0.3-0.6 m. In the fall, difference in SWC between ChF and RSF disappeared at depths below 0.6m, but was less for ChF from the soil surface to 0.6 m. WW/RSF and FW/ChF were more productive, both economically and agronomically, than FW/SW, with WW/RSF being more productive than either FW rotation by a wide margin. The FW/SW rotation produced lower yields that were more susceptible to fluctuations in crop year precipitation, contained more weeds, cost more to produce, and was less profitable than either WW/RSF or FW/ChF. Net income from the FW/ChF rotation was less variable than WW/RSF; however, net returns over total cost were consistently negative for FW/ChF and averaged \$69 rotational ha^{-1} less than WW/RSF. Even though FW/ChF yielded and earned less than WW/RSF, the FW/ChF rotation might become more viable with further research. The yield of FW following ChF was excellent in 2002 in large-scale demonstration plots, in 2003 in the main study where it out-yielded WW, and in 2006 when FW was planted into ChF without sulfentrazone herbicide. The advantages of FW/ChF include (1) spread-out fall planting and summer harvesting operations; (2) opportunities to control problem winter-annual weeds; (3) better competition with summer annual weeds than spring wheat; and (4) a late planting date that does not rely on seed-zone soil water like WW.

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A Plan for Production and Revenue Intensification at a Seattle Urban Farm

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Marra Farm is a medium sized vegetable garden in South Park, Seattle, a low-income area where local stores stock little fresh produce. Student Youth Garden Works operates a portion of Marra Farm to provide employment and training for at-risk youth, generate revenue and to supply fresh produce. Table 1 displays a revenue maximizing plan with reasonable production risk which was developed for Marra Farm.

Projected revenue and yields per square foot of area appear in columns 3 and 5 of Table 1. Three principles underlie the garden plan in Table 1. First, the plan selects the highest revenue crops within plant families. For example, under *Solanaceae*, staked tomatoes which generate $3.26/sq ft of garden area are selected. In contrast, sprawl tomatoes, eggplant, and peppers; which generate only $2.17, $1.35, and $0.95 (unlisted data), respectively, per same unit area; are excluded. Secondly, the plan utilizes double cropping to grow high revenue crops during shoulder seasons in some years. These shoulder season crops include kale for fall harvest during Year 1 (*Liliacea*) and radishes for spring harvest in Year 4 (*Cucurbitacea*). Thirdly, multiple products from the same crop are harvested when possible as with garlic spears preceding harvest of garlic bulbs. Another unlisted multiple crop would be beet tops as greens when beets are thinned prior to harvesting beet tubers. The reported revenues per square foot with the proposed garden design would generate annual revenue of $43,926. There is a possibility that the garden could be expanded to 37,026 sq ft useable space or 85% of an acre. This larger area would permit 120 beds sized 4-ft x 47-ft with 2-ft paths, generating an annual income of $94,127. A proposed business and marketing plan for Marra Farm appear in the following abstract.

Table 1. Projected Yield and Revenue for a 17,180 Sq Ft Garden, Marra Farm, South Park, Seattle, WA

Family	Crop	No. Plots	No. Sq Ft	Yield/Sq Ft	Unit	Price/Unit	Revenue/Sq Ft	Revenue/Y
Liliaceae	garlic, fall planted	2.3	685	3.0	count	0.75	2.26	1,546
	onions, green	2.3	685	1.5	bunch	1.50	2.26	1,546
	shallots	2.3	685	6.0	count	0.25	1.50	1,031
	kale	7.0	2,058	1.5	pound	2.00	3.01	6,193
Umbelliferae	cilantro	2.3	685	1.1	bunch	2.00	2.26	1,546
	carrots	2.3	685	0.9	pound	2.00	1.81	1,237
	celery	2.3	685	1.5	count	1.10	1.66	1,134
Chenopodioideae	spinach	2.3	685	0.4	pound	3.00	1.13	773
	beets	2.3	685	0.8	pound	1.25	1.03	709
	chard	2.3	685	1.0	plant	0.50	0.50	344
Cucurbitaceae	radishes (*cruciferae*)	7.0	2,058	1.5	bunch	1.95	2.93	6,038
	cucumbers, trellised	3.5	1,029	1.1	count	1.00	1.13	1,161
	squash, summer	3.5	1,029	0.5	pound	2.00	0.94	968
Leguminosae	peas, snap and snow	7.0	2,058	0.6	pound	6.00	3.31	6,812
Solanaceae	tomatoes, staked	7.0	2,058	1.0	pound	3.25	3.26	6,709
Greens	salad mix	7.0	2,058	0.5	bag	4.00	2.01	4,129
Cruciferae	broccoli	3.5	1,029	0.4	pound	3.00	1.24	1,277
	cabbage, early	3.5	1,029	0.3	count	2.50	0.75	774
Grand Total		**70.0**	**20,571**					**$43,926**

Note: Garden area is composed of fifty-six 47-ft x 4-ft plots surrounded by 2-ft paths on all sides. The total sq ft of 20,571 exceeds 17,180 because of double crop some years; 70 plots exceeds 56 plots for the same reason. Yields are based on Washington State University EB 0422. Prices are based on Marra Farm sales recor from 2008 and earlier years, when available, and from local supermarkets and investigators' estimates when Marra records were not available. The prices assume c produce commands a premium among community supported agriculture (CSA) customers.