Conservation Tillage Research and Adoption in the Pacific Northwest

Invited commentary by Dr. Douglas L. Young

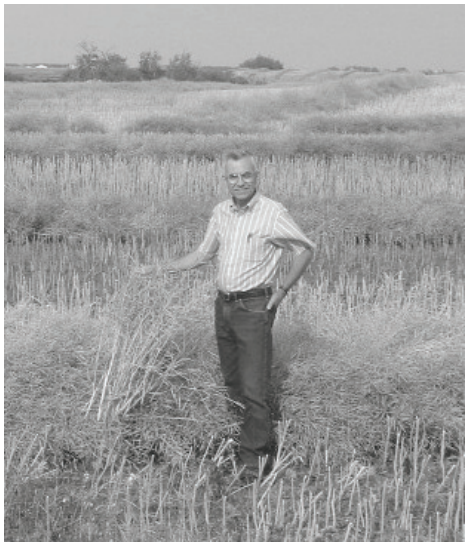
A great source of satisfaction during my 32 years at WSU has been the opportunity to work with talented agricultural and social scientists committed to developing profitable cropping systems to enhance soil, water, and air quality for Pacific Northwest (PNW) farmers. This satisfaction reflects my belief that solving societal problems requires cooperation among many disciplines. Farmers and other citizens often complain that academic disciplinary research is too often "an inch wide and a mile deep." A broad perspective on resource conservation research and extension in the PNW was pioneered by Soil Conservation Service employee, Verle Kaiser, and Pullman USDA/ERS agricultural economist, Walter Pawson. These men worked to quantify the effects of erosion on crop productivity and economic returns after World War II until the 1970's. Early farmer-inventers like Mort Swanson, and agricultural engineers including Charles Peterson and Keith Saxton, among others, improved stand establishment and yields by developing direct-seed drills with improved fertilizer and seed placement. Alex Ogg, Frank Young, Donn Thill, and others developed improved systems approaches for controlling weeds in direct seeded small grains and legumes. *Fusarium, Pythium,* and *Rhizoctonia* root diseases are a major problem in direct seeded wheat grown continuously or in two-year rotations. Plant pathologists--including James Cook, George Bruehl, Richard Smiley, Tim Murray, Tim Paulitz, and others--developed diverse rotations, tillage to eliminate the "green bridge," and other methods for reducing these diseases in direct seed and conservation tillage systems. Several PNW crop breeders developed more disease resistant varieties.

My early involvement in this research was enlisted by Bob Papendick who brought an untiring commitment and strong leadership to multidisciplinary research in the STEEP, Columbia Plateau PM_{10}, IPM Cropping Systems, and other PNW conservation projects. An early successful multidisciplinary direct seed project was the Pullman-based IPM cropping systems project led by Frank Young during 1986-94. A direct seed winter wheat/min-till spring barley/min-till spring pea rotation with appropriate chemical weed control effectively managed weeds, diseases, and soil compaction. Farmers were pleased with the system's high average profit and relatively low level of profit risk over time. The win-win relationship between profit and risk contrasts with the typical pattern of financial investments where portfolios with higher average returns typically incur higher risk. Furthermore, this system satisfied residue and acreage requirements of the 1985 and subsequent Farm Bills.

Turning to the lower rainfall wheat-fallow areas of the PNW, annual no-till spring cropping is an unqualified environmental success. Engineering modeling has shown that these systems can reduce predicted dust emissions by 94% during severe wind events compared to winter wheat-tillage summer fallow (WW/TSF). But my economic evaluations of long-term no-till annual spring cropping experiments by Bill Schillinger at Ritzville and the Horse Heaven Hills and by Frank Young at Ralston have consistently shown profit with these systems averaging $25 to over $40 per rotational acre below WW/TSF. The conventional fallow system also displayed much more income stability over years. Winter wheat/minimum tillage summer fallow (WW/MSF) has shown excellent environmental and economic prospects in low rainfall regions. Bill Schillinger and I have reported that use of a wide-blade V-sweep undercutter for primary summer fallow tillage plus fertilizer injection, followed by as few as one non-inversion rodweeding, produces statistically equivalent wheat yields and greater or equal profit. Schillinger has also documented soil moisture, surface roughness, residue, and other benefits with this system. Predicted dust emissions during severe wind events with WW/MSF were about 50% less compared to WW/TSF. An essential component of the PNW conservation efforts in both the high and lower precipitation zones has been top rate extension programs led by Kenny Morrison, Carl Engle, Roger Veseth, Don Wysocki, Hans Kok, Rich Koenig, Joe Yenish, and others. NRCS staff, including Dennis Roe and Ron McClellan, have consistently contributed key data and interpretation.

Machinery cost budgeting for direct seeding and conservation tillage by Herb Hinman, Kate Painter, and myself have shown cost savings with these systems with proper combinations of custom and owned machinery, used and new machinery, and careful matching of machinery size to direct seed and conservation-till acreage. Elwin Smith and I reported that the greatest unsung victory for soil conservation and carbon sequestration in North America has been the steady decrease in summer fallow over the past three decades. We concluded the primary reasons for the increase in cropping intensification in the American Great Plains and Canadian Prairies has been the decreasing price of glyphosate herbicide relative to diesel price and steady improvements in direct seeding technology.

David Walker and I have computed high long run productivity payoffs to soil conservation in the PNW. Our research shows that improved crop varieties, improved pest management, better nutrient management, and other technical progress has boosted yields despite soil erosion over time. However, there has been a shrinking payoff as topsoil becomes thinner. Consequently, unchecked erosion over time could eventually reduce yields despite continuing technical progress.



Doug Young inspecting windrowed canola in central Alberta.

Despite the distinguished record of PNW conservation research and extension, and the urgency to control erosion in the long run to preserve productivity and to reduce off-site damage, the PNW lags in adoption of direct seeding and conservation tillage compared to other regions. Acreage-weighted average adoption of direct seeding in small grains for the three PNW states was 11% in 2004 versus a similar average adoption rate of 24% for the three Northern Plains states of Montana and the Dakotas (Conservation Technology Information Center (CTIC), 2004). Acreage-weighted adoption in the three Canadian prairie provinces was 32% in 2001 compared to 11% in the PNW in 2004 (Statistics Canada, 2001; CTIC, 2004).

Also vexing is the inconsistent adoption of direct seeding over PNW counties as evidenced by a recent ground survey (Hans Kok and Dennis Roe, personal communication, December 2008) and a 2004 national survey (CTIC, 2004). CTIC surveys estimate that farmers in Columbia County, WA direct seeded 68% of their acres in 2004 compared to 12% in Whitman County. Oregon's Wasco County tallied 70% in direct seeding compared to 11% in Umatilla County. In Idaho, Lewis County farmers direct seeded 33% of their acres compared to 13% in Latah County.

Farmers and scientists propose diverse agronomic, agro-climatic and socio-economic hypotheses to explain low and variable rates of direct seeding and conservation tillage in the PNW. Some argue that low adoption counties confront more severe straw management, disease, weed, and topographic problems with direct seeding. Others claim custom fertilizer delivery practices inhibit direct seeding in some counties. Others posit that farmers in some high-adoption counties are more willing to burn stubble to reduce tillage at the expense of air quality. Some farmers challenge the fundamental soil conserving superiority of direct seeding and conservation tillage. They describe practices like turning moldboard plow furrows uphill, or a unique hybrid tillage system, that they claim saves soil just as well as direct seeding, but is more profitable, albeit not endorsed by NRCS or the scientific community.

A common socioeconomic explanation is that high-adoption counties have benefited from more effective educational programs. For example, Roland Schirman, an effective Extension advocate of direct seeding in Columbia County, WA, is credited for achieving 70% adoption of the practice in that county. One of Schirman's early assistants, Dusty Eddy, NRCS, is credited for similar success in Wasco County, OR. Some strong direct seed adopters might argue that farmers in high-adoption counties possess stronger stewardship values or place more value on being pioneers in conservation farming.

Although I have thought a long time about the low and variable adoption rate of direct seeding and conservation tillage in the PNW, I cannot pinpoint a single explanation. My best speculation is "all of the above, depending on the situation." Weed, disease, and straw volumes correlated with higher precipitation might be a plausible explanation for low adoption in at least some subregions within Latah, Whitman, and Umatilla counties. STEEP-funded surveys of farmers by Don Dillman, John Carlson, myself, and others lend strong support for high quality and sustained conservation education programs in promoting adoption. However, more research is needed to uncover regionally specific barriers to direct seeding.

I remain optimistic that targeted research on resolving barriers to direct seeding and conservation tillage in the PNW will eventually narrow the gap between conservation practices in our region and elsewhere. Iowa State University and Yale University economists have estimated that taxpayer investments in agricultural research at the nation's land grant universities and at USDA/ARS have yielded up to 50% rates of return since the 1970's in terms of higher grain yields. Most of these benefits are transferred to domestic and foreign consumers through lower food prices. At this point, the challenge to researchers will be to sustain higher production with resource conserving sustainable production.