

Summary: CP₃ Highlights and Priorities for the Future

The Columbia Plateau PM₁₀ Project (CP₃) is now in its 11th year of research and education on control of wind erosion and PM emissions from farmlands of the Columbia Plateau and Columbia Basin Major Land Resource Areas of Oregon and Washington. During this time the Project has made significant contributions to improve our understanding of the relationships between wind erosion and dust emissions, and requirements for their control on the different soils of the region. Yet, much remains to be done in furthering this work and, especially toward achieving broad-scale implementation of control practices on farm fields. The Project is mature with a well-coordinated team effort, and has the momentum to continue its work of protecting topsoil and improving air quality for the benefit of those who live and work in this region and indeed for the entire nation.

Wind erosion is a persistent problem on the Columbia Plateau because of its dry environment, limited vegetative cover, high winds, intensively tilled soils, and loess soils that contain significant amounts of free PM₁₀ (particulates 10 microns or less in aerodynamic diameter). It is most severe in the low precipitation zones (12 inches and less annual precipitation) where wheat-fallow is the predominant farming system on 3.84 million acres, and on the irrigated fields of the Columbia Basin when the land lacks cover. The potential for dust blowing from farmlands into urban centers is greatest when high winds occur during spring and fall planting or after harvest of irrigated crops when the tilled, dry soils lack protective cover.

In earlier times a primary concern with wind erosion was loss of topsoil because the productivity of agriculture depends on this relatively thin mantle

of soil, which if lost, cannot be replaced in the scale of human lifetimes. Today, loss of topsoil is still a primary concern. However, with the Clean Air Act Amendments of 1990, particulate matter (PM₁₀ and PM_{2.5}) in windblown dust is now regulated by the US Environmental Protection Agency (EPA) as one of six "criteria" atmospheric pollutants, and one of major concern to agriculture. Fugitive dust from wind erosion on tilled croplands is a primary source of ambient PM on the Columbia Plateau along with contributions from construction sites, unpaved roads, wood smoke and various agricultural field and processing operations.

Thus far, agriculture on the Columbia Plateau and Columbia Basin has not been implicated as contributing to nonattainment due to increases of PM₁₀ and PM_{2.5} in the atmosphere. Much of this is attributed to grower awareness of the PM problem and their use of conservation measures developed and promoted by CP₃ research and education along with grower input and innovations. However, in the event an area is designated as nonattainment for a criteria pollutant it falls to the state to prescribe control measures for meeting air quality standards. If this fails, EPA is responsible for action to bring the pollution under control. In either case, the nonattainment designation will require growers to go beyond the stewardship that they may now be practicing in order to return to attainment status.

This book emphasizes control of wind erosion and PM emissions through grower application of 'Best Management Practices' [(BMP) in CP₃ terminology, and 'Best Available Control Measures' (BACM) or 'Reasonable Available Control Measures' (RACM) in EPA terminology]. Research consistently shows that the most practical, effective

and universal approach for achieving BMPs on Columbia Plateau farmlands is through management practices that emphasize surface cover and soil roughness. Because of the research focus of the CP₃, this report is largely devoted to this theme. However, in special cases other control measures should be considered such as tree windbreaks, grass strips, strip-cropping and soil stabilizing amendments.

HIGHLIGHTS

EPA IMPLEMENTS NEW PM_{2.5} STANDARD AND EXCLUDES VIOLATIONS OF STANDARDS FROM NATURAL EVENTS.

In their designation of nonattainment areas, the EPA is implementing an annual average PM_{2.5} standard of 15 micrograms per cubic meter of air and a 24-hr PM_{2.5} standard of 65 micrograms per cubic meter. Final rules are expected by September 2004. Based on 2000-02 data, no areas in Washington have violated the PM_{2.5} standard. The annual average PM₁₀ standard of 50 micrograms per cubic meter and 24-hr standard of 150 micrograms per cubic meter is retained.

Currently EPA's Natural Events Policy (NEP) excludes PM violations due to natural events (high winds) provided that the appropriate state regulatory body (Department of Ecology in Washington State) verifies that BMPs had been implemented in the source area. If it is determined that BMPs were not implemented in the source area the violations may not be discounted and the area could be classified as "serious nonattainment" with requirements for stricter controls on all sources of PM. Presently no area in Washington state is designated as "serious nonattainment."

Spokane, WA is currently classified as a “moderate nonattainment” area for PM₁₀ because of violations from sources other than high winds (e.g., unpaved road dust and wood smoke). In 2001 EPA classified the Wallula area in south central Washington as serious nonattainment for PM emissions. However, a review concluded that the PM₁₀ violations were due to high wind events and that on the four dates in question the sources were controlled with BACM.

LAKE CORE STUDY INDICATES THAT GRAIN-FALLOW AGRICULTURE MARKEDLY INCREASED DUSTINESS OF THE COLUMBIA PLATEAU

An 8.4 ft sediment core extracted from the bottom of Fourth of July Lake, a pothole lake in the Palouse area that has no apparent inlet or outlet, was used to reconstruct the geologic history of dust deposition both before and after farming began in the region. Age dating by depth was accomplished by analysis of core sections for plant macrofossils, fossil pollen, radioisotopes from nuclear fallout of known dates, ash depositions from volcanic eruptions with known dates, and radiocarbon dating. Sediment analysis consisted of mass per unit area and mean particle size. Radiocarbon dating placed the age of the bottom of the core at approximately 620 AD.

The results provide evidence that wheat-fallow agriculture beginning in the 1880s increased the sediment flux (dustiness) in the region by at least 4-fold. From that time on sediment transport and the concentration of fine particulates increased, both likely from increased wind erosion due to loss of natural vegetation and intensive tillage of the fine-textured loessial soils.

The study strengthens and reinforces the case that to reduce dustiness on the Columbia Plateau growers need to employ practices that maintain adequate soil cover and surface roughness, and minimize or eliminate tillage that increases the soil’s susceptibility to wind erosion. However, from a broader perspective the study does not go back far enough in time to allow comparisons of present levels of dustiness with natural variations in prehistoric environments during formation of the Palouse landscapes. Studies are currently underway to reconstruct loess accumulation from dynamic source areas in the Plateau region under the controlling influences of climate, plant cover and topography to quantify dust

fluxes on a much longer geologic time scale than in the Fourth of July Lake study.

MODEL DEVELOPMENTS AND SOIL STUDIES IMPROVE PREDICTION OF WIND EROSION AND PM EMISSIONS FROM COLUMBIA PLATEAU CROPLANDS

A wind erosion equation developed from research in Kansas was calibrated for Columbia Plateau conditions and coupled with an aerodynamic vertical flux equation to estimate PM₁₀ flux from eroded soil with known PM₁₀ content during a dust storm event. The model performed successfully as an emissions subroutine for a regional air quality model in comparisons of predicted vs measured downwind PM₁₀ concentrations in simulating performance of land-applied conservation measures during storm events.

CP₃ studies indicate that suspension, not saltation as previously believed, is the dominant mechanism of wind erosion in the fine-textured, loessial soils that are prevalent in much of the Columbia Plateau. New methods, theories and approaches have been required to describe, measure and predict suspension-dominated wind erosion. Best management practices for its control are those that provide adequate soil cover and roughness, and limit the amount of available PM for emission during wind erosion.

New relationships based on soil aggregate size that account for either suspension- or saltation-dominated erosion were used to predict soil erodibility across the Plateau region. These data show soil erodibility is highest in the southwest portions of the Plateau where the soils are coarse-textured and that it decreases in a northeasterly direction as the soils become finer-textured. A map of available PM₁₀ (fraction of PM₁₀ in the soil mass) shows that PM₁₀ contents of soils are lowest in the western and south-central parts of the Plateau where soils have relatively high sand contents and are highest to the north, east and southeast where the soils have higher silt, clay and organic matter contents.

A map of PM₁₀ emission hazard (product of the available PM₁₀ and soil erodibility) shows the highest emission hazard lies in a northwest to southeast pattern through the east central region of the Plateau with additional non-contiguous areas around the periphery. It is lowest in the western part of the Plateau and to the south where both soil erodibility and PM₁₀ content of the soils are relatively low. These

improvements to predict soil dust potential with the emissions routine, along with updates in the meteorological forecasting system, have contributed to major advances in regional modeling of atmospheric dust fluxes and PM concentrations on the Columbia Plateau and areas downwind.

SOIL COVER SUPPLEMENTED WITH RANDOM OR ORIENTED SURFACE ROUGHNESS HIGHLY RECOMMENDED FOR CONTROLLING WIND EROSION AND DUST EMISSIONS

Soil loss ratio (SLR) relationships together with wind erosion and air quality model simulations indicate that 25 to 30% residue cover can significantly reduce wind erosion on farmlands and hold PM₁₀ concentrations below the EPA limit during major dust storms. The CP₃ research suggests, conservatively, that practices which achieve a minimum of 30% residue cover should qualify as BMPs in most situations. The cover is less stringent if supplemented with soil roughness or other control measures. Widespread application of cover/roughness-based BMPs during critical times should be sufficient to bring PM emissions into compliance with EPA air quality standards except in cases of extreme natural conditions, thereby invoking EPA’s Natural Events Policy.

CONSERVATION TILLAGE RECOMMENDED AS A BMP REPLACEMENT FOR CONVENTIONAL TILLED WHEAT-FALLOW

Bare, loose soil resulting from conventional tillage during fallow is a major source of dust from wind erosion on the Columbia Plateau. CP₃ research in a 10-inch annual precipitation zone showed that minimum and delayed minimum tillage fallow that reduced the number of tillage operations to three to five from the typical eight or more with conventional tillage consistently achieved 30% or more residue cover, and increased surface roughness compared with conventional tillage that less frequently met erosion control requirements for a BMP. Moreover, the conservation tillage systems equaled the profitability of the conventional tilled winter wheat-fallow system. Simulations with the regional air quality model estimate that application of conservation tillage fallow would reduce downwind PM₁₀ concentrations by at least 50% compared with conventional tilled fallow.

EARLY PLANTING AND CROSS-WIND SOWING INCREASES COVER AND ROUGHNESS AFTER FALLOW

CP₃ studies show that sowing winter wheat early (mid-to-late August) results in greater straw production, and grain yields more frequently than sowing in September or October. Maximizing straw production in combination with conservation tillage fallow helps to ensure year round protection against wind erosion in the wheat-fallow system. Cultivars with good yield potential tend to be good straw producers. Moreover, green cover from wheat seedlings emerging in late August/early September can provide significant ground cover by October for added protection against wind erosion.

A delay in planting date markedly reduces green cover because early biomass accumulation is slow and temperatures decrease rapidly after mid-September on the Plateau. Sowing perpendicular to the prevailing wind direction with deep furrow drills creates oriented soil roughness that slows wind speeds in the furrows, thus, reducing suspension and trapping moving particles. Early planting and cross-wind sowing should be a standard practice used in conjunction with conservation tillage fallow.

WINTER WHEAT IN ROTATION WITH NO-TILL SPRING CEREALS: A POTENTIAL BMP FOR DRYLAND CROPPING

Spring barley and spring wheat are well adapted to an 11-inch and higher annual precipitation zone when 5 inches or more over-winter precipitation is stored in the soil. With no-till sowing these crops show economic potential when produced in rotation with winter wheat. The cropping system retains winter wheat as the principal crop and compared with wheat-fallow it increases the cropping intensity and thus, provides cover on the land a greater percentage of the time.

Cropping options include winter wheat-spring cereal-fallow or a second year of spring cereal in place of fallow the third year. Spring cereals are sown with a no-till drill into the winter wheat or spring cereal stubble. A CP₃ field experiment conducted in a 13-inch annual precipitation zone with normal precipitation one year and above normal a second year showed that residue amounts after no-till sowing with several different drills provided 70 to over 90% ground cover

for either of the preceding crops within the no-till treatments. Even with conventional tillage in the annual cropping phase, residue cover before crop establishment provided adequate protection against wind erosion.

Though no economic assessment of the cropping systems was conducted the no-till barley yields were well within the range considered as profitable for growers. It is not economically feasible to follow barley with winter wheat because of possible contamination of wheat by volunteer barley but this is not a problem with spring wheat of the same market class as the winter wheat. To avoid this, a year of fallow usually precedes the winter wheat crop. The BMP recommendation then is to apply conservation tillage fallow starting with spring cereal stubble after harvest.

ANNUAL NO-TILL SOFT WHITE SPRING WHEAT: A POTENTIAL REPLACEMENT FOR WINTER WHEAT-FALLOW?

A 5-year experiment in an 11-inch annual precipitation zone with alternative no-till spring crop rotations showed that the most profitable no-till spring cropping system was continuous soft white wheat with average net returns that were statistically equivalent to winter wheat-fallow and significantly greater than that from oil seed-spring wheat and spring barley-spring wheat rotations. This is the first known result where a continuous no-till spring cropping system was as profitable as traditional winter wheat-fallow on the Columbia Plateau drylands.

This finding is supported by an economic analysis of no-till spring crop production on a nearby grower's farm showing the net return from continuous no-till soft white spring wheat was greater than from spring cereal and spring cereal-oil seed rotations. Annual no-till cropping provides year round protection against wind erosion and potential for increased water use efficiency as well as energy and labor savings in the farm operation. Other than the continuous soft white spring wheat system, economic assessments show that annual no-till spring crop rotations cannot compete with winter wheat-fallow, both in net returns and income stability (see next highlight). Oilseed crops provided no rotational benefits for disease or weed control and left less available soil water for the following one or two cereal crops, thus, growers in the low precipitation zones may benefit more by planting continuous spring cereals.

WINTER WHEAT AFTER SPRING WHEAT OUTYIELDS ANNUAL SPRING WHEAT IN CONTINUOUS NO-TILL SYSTEMS AT LIND, WA.

Yields of soft white winter wheat after three years of soft white spring wheat in a continuous annually-cropped no-till system were significantly higher three out of four years (2000, 2002, and 2003) than yields of continuous no-till soft white spring wheat at Lind, WA. Yields of winter wheat ranged from 40 to 13 bu ac⁻¹ and spring wheat from 24 to 9 bu ac⁻¹ during the four years of trials. In 2001 when yields for the two systems were similar, both crops were adversely impacted by drought and the winter wheat was further damaged by a late May frost during the flowering stage that did not affect the spring wheat.

The results of this work has raised interest in the possibility of producing winter wheat in rotation with spring wheat as opposed to annual spring wheat cropping in continuous annual no-till systems. Three years of spring wheat helps to control winter annual grass weeds, such as downy brome, when the rotation reverts to winter wheat. In addition, Russian thistle, a major broadleaf weed and serious obstacle for spring-grown crops, was never a problem in winter wheat. The no-till winter wheat-spring wheat system is a potential BMP for wind erosion control and warrants further research under different environments and cropping sequences in the dryland areas.

CONTINUOUS NO-TILL HARD RED SPRING WHEAT NOT ECONOMICALLY COMPETITIVE WITH WINTER WHEAT-FALLOW

CP₃ field experiments at two dryland locations, one at Ralston (7-yr trial, 11.4-inch annual precipitation zone) and the other in the Horse Heaven Hills (6-yr trial, 6.5-inch annual precipitation zone) showed that continuous no-till hard red spring wheat performed well agronomically in years of normal and above normal precipitation but consistently lagged soft white winter wheat-fallow in farm profitability. Hard red spring wheat was not economically competitive with winter wheat after fallow in either wet or drought crop years. Droughts were especially devastating to the yields of continuous spring cereals at both sites but more so in Horse Heaven Hills than at Ralston. Moreover, economic risk in the form of yield variations was greater as were the effects of drought

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on yields with annual cropping compared with fallow, but was comparatively less at Ralston than the drier Horse Heaven Hills site.

NO-TILL SOWING INTO IRRIGATED WINTER WHEAT STUBBLE OFFERS A REPLACEMENT TO BURNING AND PLOWING

A common practice with deep-well irrigators is continuous winter wheat production by burning the stubble and plowing each year in preparation for sowing the next crop in September. Burning rids the fields of stubble that hamper sowing and plowing controls weeds and prepares the seedbed; however, both practices are detrimental to air quality. Burning produces smoke emissions and plowing increases the wind erosion hazard, moreover, plowing impairs soil quality. CP₃ research seeks to replace the burn/plow system with alternative no-till rotations that eliminate burning and sequence spring cereals and/or oilseeds with winter wheat.

Third year results showed no yield differences for any crop in a 3-yr rotation of winter wheat–spring barley–winter canola sown no-till into standing stubble compared with stubble mechanically removed or burned. However, in the third year but not in the first two years, winter wheat in the 3-yr rotation produced a significantly higher yield compared with the continuous winter wheat sown after burning and plowing. The incidence of several diseases of winter wheat was low to moderate in all treatments except for continuous annual winter wheat after burning and plowing where take-all was a major problem in 2003. It was not a factor with the winter wheat grown in rotation with the barley and canola. Moreover, soil analysis indicates that soil quality in no-till plots without burning is improving compared with burn and burn/plow treatments.

A GROWING DEGREE DAY MODEL PREDICTS DRY MATTER AND COVER PRODUCTION AFTER SOWING IRRIGATED COVER CROPS

Irrigated areas often depend on cover crops for protection against wind erosion during the interim between crops, or after harvest. It is important that cover crops are sown early enough before cool weather to establish sufficient growth to protect the soil. Crops such as wheat, rye, triticale, and mustard vary in their response to temperature (growing degree days) and, thus, their production of biomass and ground cover. The model developed

from CP₃ research emphasizes the importance of early sowing (August, early September) to achieve adequate cover before fall windstorms begin; moreover, it shows that extreme seasonal variations can cause differences of over 1 ton ac⁻¹ in dry matter production during the late summer-fall growing period.

The model predicts the extent to which crops vary in the amount of biomass required to produce the 30 to 50% ground cover required for satisfactory control of wind erosion. For example, triticale accumulates biomass faster and provides more canopy cover per unit of biomass than crops such as rye, canola, and winter wheat. The growing degree day model has been integrated with GIS long-term weather maps to predict biomass and ground cover from different crops as a function of planting date across the regional microclimates of the irrigated Columbia Basin, with capability to account for seasonal variations as well.

COVER CROPS RECYCLE SOIL NITROGEN AND REDUCE LEACHING IN IRRIGATED CROPPING

Winter cover crops have the potential to recover and release excess soil nitrogen for a subsequent crop and thereby reduce grower expense for fertilizer nitrogen. These savings help to offset the cost of producing cover crops and encourages their use for the added benefit of wind erosion control. Nitrogen recovery follows the growth pattern of the crop and varies with planting date and location.

CP₃ studies showed that several crops sown in August in the south Columbia Basin accumulated 100 to 125 lb ac⁻¹ of nitrogen whereas they recovered less than half of this when sown in September in the north Columbia Basin. The mineral nitrogen recovered by these crops significantly reduced the over-winter leaching potential to a depth of six ft compared with bare fallow and provided timely amounts of available nitrogen to the following potato crop. Crops that serve a dual purpose as nitrogen scavengers and cover include annual ryegrass, winter wheat, sorghum-sudan, triticale and oat.

REMOTE SENSING SHOWS POTENTIAL FOR ASSESSING COVER CROP USE IN IRRIGATED AREAS

While growers have used cover crops in the irrigated areas for many years there is little information on acreages and extent of ground cover on a regional basis, especially during

the non-growing season when there is a high wind erosion hazard. Satellite imagery was successfully used on a large-scale to differentiate bare, smooth fields including those with inadequate residue from those with sufficient residue or green cover for protection against wind erosion. The procedure does not identify nitrogen-scavenging crops since radar imagery does not distinguish actively growing vegetation from heavy residues or rough surfaces.

ON-FARM TESTING PROGRAM ACCELERATES DEVELOPMENT AND ADAPTATION OF CONSERVATION FARMING SYSTEMS FOR WIND EROSION CONTROL

On-farm testing is a powerful adjunct to university field plot research through its involvement of growers applying replicated, statistically valid field trials for making treatment comparisons on their own farms with their own equipment. The approach supplements long-term field plot research by responding to growers' need for more immediate information on agronomic and economic impacts of implementing new management systems to address changes in farm programs, environmental concerns and economic conditions.

For example, on-farm testing showed that increasing rates of late-fall applied nitrogen fertilizer for no-till hard red spring wheat did not guarantee grain protein contents required for a premium price. High protein is best assured by early fall application of nitrogen fertilizer and/or by higher levels of residual soil nitrogen in the fall prior to the spring crop. Nevertheless, investments in the higher rates of nitrogen fertilizer were usually recovered by increased grain yield and protein content by the spring crop.

Tests with minimum tillage and no-till systems showed that net returns over fertilizer, or fertilizer plus seed and interest costs were, for the most part, significantly greater for soft white than hard red spring wheat. This was largely due to higher grain yields from soft white wheat. Selecting varieties for yield potential, and proper sowing rates were important considerations in the profitability of no-till soft white spring wheat production. With spring barley there were usually greater differences among direct seeding methods (e.g., using different no-till drills) than between direct seeding and conventional planting although direct seeding saved time in field operations. The

on-farm testing program is enthusiastically supported by area growers and has been an asset to CP₃ efforts in developing best management systems for wind erosion control.

THE CP₃ EXTENSION EDUCATION PROJECT EFFECTIVELY DISSEMINATES INFORMATION ON NEW METHODS AND TECHNOLOGIES FOR WIND EROSION CONTROL

The CP₃ Education Project works closely with STEEP (Solutions to Environmental and Economic Problems) and related programs in the transfer of conservation tillage management technologies to a variety of user clientele. The outreach from this work extends to an audience of several thousand or more.

Grower and general public awareness of wind erosion and air quality issues has been markedly increased by educational efforts using a variety of approaches. These include an annual Northwest Direct Seed Cropping Systems Conference with an attendance of 600 to 900; direct seed e-mail/list server with an address list of about 500; publications including journal papers, abstracts, extension publications, and Ag media articles; and conservation tillage field days and tours (38 in 2002) highlighting new cropping systems technologies for direct seeding in the Northwest and neighboring regions. These events are widely advertised in brochures and newsletters by mail, the Internet and in regional newspapers. The educational efforts have helped to form a strong communication network and partnership among growers, researchers, agricultural support groups, federal and state conservation and regulatory agencies, and the agricultural industry to accelerate development and implementation of conservation farming systems in the region.

CONSERVATION FARMING DOES DOUBLE DUTY BY SIMULTANEOUSLY IMPROVING AIR AND SOIL QUALITY

The soil ecosystem and its proper functioning are key to soil quality that controls the agronomic, economic and environmental performance of most cropping systems. Soils with healthy ecosystems are generally more productive and resistant to erosion than degraded soils. Practices such as no-till that minimally disturb the soil, add organic matter to it, and provide cover from crop residues and vegetative growth, help to control wind erosion and improve soil quality in both dry and irrigated croplands of the Columbia Plateau and Columbia

Basin Major Land Resource Areas. Soil carbon content was approximately 10% higher after five years of continuous no-till spring cereals compared with wheat-fallow due to more efficient carbon metabolism in the no-till system. Tillage is also detrimental to soil aggregation needed to stabilize soils with a low organic matter content against wind erosion.

A simple test with a dryland soil showed that the aggregated fraction of soil after five years of no-till cereal cropping was more similar to that from a perennial grass lawn and considerably greater than soil from a wheat-fallow field. Studies also show that soil quality indicators in soils after 10 years in sod under the Conservation Reserve Program (CRP) are more similar to those for long-term no-till than conventionally tilled cropland soils.

SURVEY INDICATES SMALL CHANGES IN APPLICATION OF RESIDUE MANAGEMENT DURING PAST 13 YEARS

Long-term research and grower experience indicates that 30% or more residue cover is required for effective control of soil erosion by wind during critical periods unless supplemented by other control practices. A crop residue management survey of seven wind erosion prone counties in Washington reported by the Conservation Technology Information Center (CTIC) showed that the percentage of farmland by county meeting the 30% residue requirement ranged from 15 to 55% during the study period (1990-2002). Only one county showed an increase in the use of 30% residue cover during the survey period.

Land in the USDA's Conservation Reserve Program was the dominant conservation practice in four counties and percent CRP acreage has remained relatively constant in individual counties during the 13 years. Counties showing least use of residue management were in the lower precipitation zones where wind erosion is most severe. Averaged over seven counties there was no change in the use of crop residue management during the past 13 years. The percentage of farmland meeting the 30% residue cover standard averaged 37% with about 20% in CRP, 11% in planted cropland and 6% in fallow. The survey indicates that there is considerable need to increase the use of conservation farming practices to protect croplands against wind erosion and dust emissions on the Columbia Plateau and Columbia Basin Major Land Resource Areas.

2002 FARM BILL PROGRAMS ADDRESS AIR QUALITY ISSUES

While the 2002 Farm Program expands the size and scope of agri-environmental programs it shifts emphasis from land retirement to conservation funding and stewardship on working lands. Three programs contain provisions that specifically address wind erosion and air quality concerns. These are the Conservation Reserve Program (CRP), Environmental Quality Incentives Program (EQIP), and the Conservation Security Program (CSP).

The CRP is a continuation of an ongoing program that provides payments and cost sharing to establish and maintain perennial cover on environmentally sensitive lands. The Farm Bill increases the national acreage cap for the program from 36.4 to 39.2 million acres. EQIP is a voluntary program that provides technical and financial assistance to crop and livestock producers for applying structural and management conservation practices on eligible farmlands (e.g., wind erosion control). The CSP is a new voluntary conservation program that provides technical and financial assistance to growers for adopting management practices that address either or both local or national resource concerns, one being air quality. Growers in wind erosion prone areas need to contact their local NRCS office for details on these programs and since they are voluntary, to initiate participation in them where appropriate.

LOOKING AHEAD: RESEARCH AND EDUCATION PRIORITIES FOR THE FUTURE

The Columbia Plateau Wind Erosion/Air Quality Project is mature and since inception its organization and team approach has demonstrated capability in finding solutions to wind erosion and dust emission problems on a regional scale. Though much has been accomplished in research on wind erosion prediction and control technologies, much more needs to be done on application of control measures on farmlands. This requires an understanding of how conservation farming on regional and local scales impacts air quality, and the challenges and opportunities involved with grower adoption of wind erosion control practices. The program is in place to move wind erosion and air quality research and education forward into the next phase toward the goal of developing and implementing

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technologies for preserving a sound agricultural and industrial economy and improving air quality to ensure a healthy environment in the region.

The following are considered as the top ten priorities for future activities on the Columbia Plateau Wind Erosion/Air Quality Project. They are not listed in order of individual priority.

1. Develop prediction technology for suspension-dominated wind erosion for integration with the Regional Air Quality Prediction Model.
2. Refine the Regional Air Quality Prediction Model for mapping PM concentrations across the Columbia Plateau during major dust storm events.
3. Predict impacts on regional air quality of applying different levels of cover and roughness for wind erosion control on the major soil types on the Columbia Plateau.
4. Improve prediction of soil susceptibility to wind erosion by relating the spectra within pixels of satellite images to the roughness component of the soil loss ratio.
5. Compare dynamics of soil water during 13-mo chemical fallow with conventional tillage fallow in low precipitation areas as affected by soil type and residue management, and impacts on winter wheat growth and grain yield.
6. Develop continuous reduced- or no-till spring cropping systems or systems that are flexible for rotation with minimum-till winter crops or chemical fallow, and are equally or more profitable than conventional winter wheat-fallow.
7. Investigate opportunities through plant breeding, nutrient management and pest control for reducing costs and risks with continuous annual spring cropping and other conservation systems that are adaptable to the dryland zones.
8. Quantify carbon sequestration in major dryland soils with continuous no-till cropping systems compared with tilled and chemical fallow rotations.
9. Conduct disease management research to control soil-borne pathogens in no-till and minimum tillage dryland cropping systems.
10. Accelerate on-farm testing and extension outreach programs to enhance grower adoption of conservation farming systems at the farm level in zones prone to wind erosion.