CONTRIBUTING EDITOR

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The continuing fight with sediment

Most irrigation systems must be tailored for an individual field and no single irrigation method is best for all situations. Each method has advantages and disadvantages that make it better suited for one set of conditions over another. When improving or replacing an older system, sprinkler, surface or drip systems are often compared. Sprinkler systems are adapted to a wider range of conditions than are either drip or surface systems; however, any one of them may be used under some conditions.

Critical comparisons between systems can only be made for these overlapping conditions where any one of them can be used. In some cases, the decision is obvious. For example, sprinkler systems usually are better on soils with high intake rates or on rolling topography. Likewise, surface irrigation may be the most economical on land that has been or can be easily leveled, has low to moderate intake rates, and flat slopes. In deciding between alternatives, the total operating cost is becoming more important because of energy costs. Where either surface or sprinkler systems can be used, it is unwise to assume that surface irrigation will always be only 50% efficient. By using automation, farm ponds, reuse or tailwater recovery systems and sediment retention facilities, many apparent disadvantages of surface irrigation can be overcome. These features will be more widely used and should be considered in designing a new system or updating an older one.

Storage Ponds and Reuse Systems

Automated surface and sprinkler systems require a relatively clean water supply, whereas water deliveries, particularly from tailwater recovery systems and canals often contain sediment and trash. Small reservoirs or storage ponds located at or near the upper end of a field or farm can be used to remove sediment and trash from the incoming water. Also, small continuous streams or intermittent water deliveries can be accumulated and, within limits, water can then be supplied to the irrigation system on demand. The supply rate and duration can be varied as required by automated systems. Reuse ponds could partially serve these purposes, but they are usually located at the bottom of a field, where they also serve as sediment retention basins, while the best location for a storage pond is at the upper end of the field.

A small tailwater pit or sump can be used to collect runoff water for pumping to the supply reservoir. The cost of pumping tailwater for reuse is comparatively small and, for practical purposes, is the same whether the storage pond is located at the top or bottom of the field. When the pond is located at the top of the field, alternative methods are needed to trap sediment and prevent it from le[illegible] solution is to use vegetative filter strips and/or mini-basins to remove sediment from the runoff water.

Vegetative Filter Strips

Vegetation can be very effective in removing sediment from flowing water because it reduces the flow velocity. Although different kinds of vegetation can be used for filter strips, additional research is needed to determine the types which are the most effective and best suited for various cropping systems as well as the best management practice for them.

Preliminary research results recently reported by Charles Brockway (Vegetative Buffer Strips for Sediment Retention in Irrigation Runoff by Charles E. Brockway, Proceedings of the ASCE Irrigation and Drainage Division Specialty Conference on Water Management for Irrigation and Drainage. July 1977, Reno, Nevada.) show that filter strips could be formed at the lower end of a field of spring wheat by multiple plantings of wheat. The strips were planted one month after field planting with an 8-foot grain drill across the slope perpendicular to the original planting and the irrigation corrugates. The amount of sediment in the runoff water from these plot areas with single and double planting rates over the original planting was compared to that from a check plot. The sediment yield during a typical irrigation and for the season, was much greater from the area which did not have a filter strip as shown in Fig. 1.

The total amount of water applied to each plot averaged about 20 inches with 6 inches of runoff (30% for an average net application for the season of 14 inches.) The estimated irrigation efficiency based on the estimated plant consumptive use was 64%.

The effectiveness of a vegetative filter depends strongly upon the stand density or the number of plant stems per unit area. The amount of sediment leaving the field was approximately inversely proportional to the stand den-

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Comparison of sediment in runoff water from mini-basins with grass- and plastic-covered berms vs check furrows without a sediment trap.

Basin Size and Type*	Sediment Loss Thousands of lbs/acre Checks	Basins	Sediment Removal Efficiency of Basins
3 g	12.0	.83	93
3 p	14.8	.62	95
4 g	13.1	.36	96
4 p	9.9	.64	93
5 g	15.8	.56	96
5 p	14.4	.69	95

** 3 g = basin 3 furrows wide with grass-covered berm.*
5 p = basin 5 furrows wide with plastic-covered berm.

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sity in the filter as shown in Figure 2. The stand density of the spring wheat was increased 57% by double planting which decreased sediment loss by 79% compared to the check or no-filter plot. With a dense-growing crop, such as grain, the filter can be formed by multiple plantings of the same crop.

When a large-stem, widely spaced crop such as corn is grown, another crop such as grass, alfalfa, or grain may be planted for the filter strip. With a row crop, the filter strip can usually be planted in the tractor-turn area which normally is either not cropped or has subnormal production. In some cases a very small amount of cropped land may be needed, but with good management, such as harvesting the vegetative strips,

Mini-basins with grass and plastic overflow sections on bean field. (Courtesy of C. E. Brockway, University of Idaho, Twin Falls Research and Extension Center)

a net benefit can result from water quality enhancement and retaining productive soil on the farm.

Grass is an efficient filter and may become inundated and killed if the sediment load is too large. However, when most of the sediment settles before reaching the grass filter, such as in a mini-basin, the grass is able to grow through the trapped sediment and maintain its filtering ability. Laboratory results from the University of Kentucky indicate that filter strips can be used alternately with bare areas to solve this problem. Each strip tends to form a barrier which slows the water and causes ponding immediately upstream causing the sediment to settle. Further field study is needed to determine operating and design criteria before this is recommended. It may be more practical to use combination filter strips with taller stiff-stemmed plants such as grain and grass. The coarse-stemmed grain filter strip would remove the larger sediment particles and be more resistant to bending and inundation while the grass filter would trap the fine sediment particles which escape.

Figure 1. Sediment yield during a typical irrigation and for the season from field plots of spring wheat with filters of different plant density (University of Idaho, Research and Extension Center, Kimberly, Idaho).

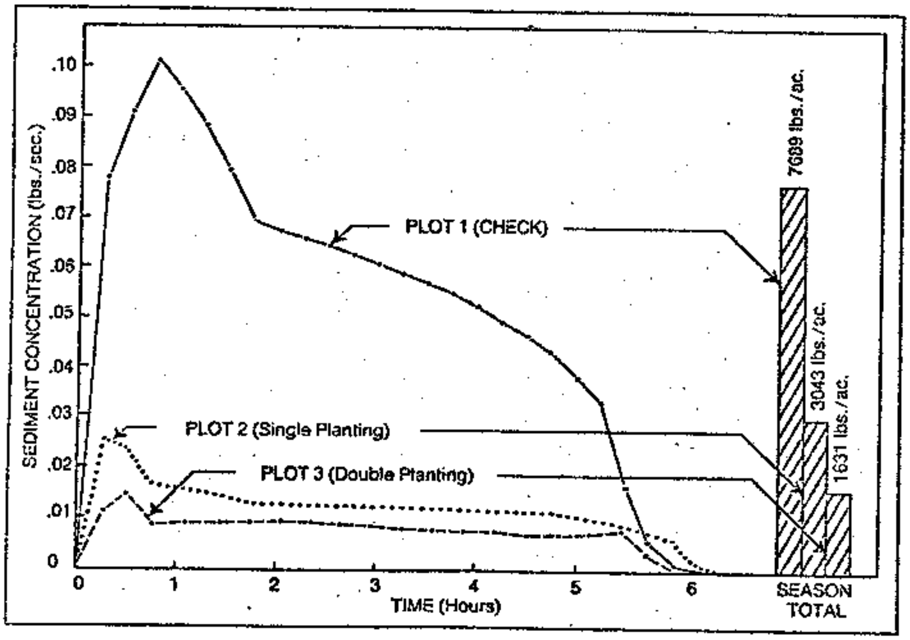
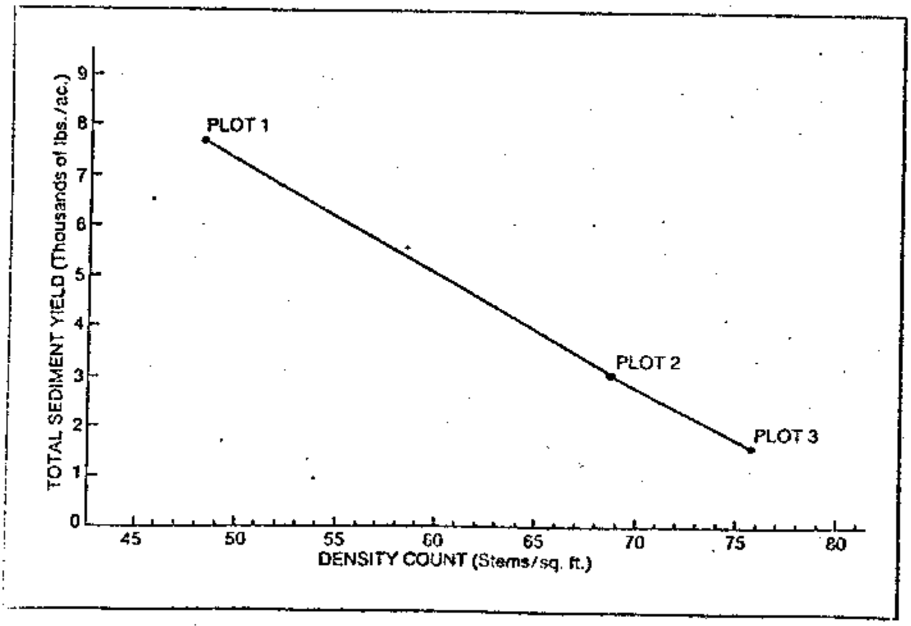


Figure 2. Sediment yield vs. stem count for vegetative filter strips in wheat field.



Mini-Basins

Another very effective method of controlling sediment loss from farm fields is to use small shallow basins. These mini-basins slow down runoff water before it enters a drain ditch. They are constructed by building small dikes spaced several furrows apart at the end of the field (Fig. 3). Sediment in the furrow runoff is retained in the basins while the water flows over narrow grass filter strips or plastic-covered berms into a drain ditch. Brockway used level overflow berms 1.7 feet wide covered with either plastic or transplanted blue grass sod. The basins were either three, four, or five furrows wide. Four basins of each width, two with plastic-covered berms and two with grass-covered strips were studied.

The total sediment loss from the field during four irrigations was 15 to 36 times greater from the check furrows compared to furrows with mini-basins. The average sediment loss from the field was 13,300 pounds per acre without the basins compared to 610 pounds per acre with the basins. Thus, 95% of the sediment was trapped and retained on the field by the basins. Grass berms performed as well as those covered with plastic and are easier and more economical to construct and maintain. Sediment removal efficiency was about the same for all basin sizes even though the average basin depth was less for the larger basins. One three-furrow basin filled after five irrigations indicating that the larger basins will more likely remain effective over a full season. Many fields are managed so that the end of the field becomes convex-shaped and erosion is accelerated. This lowers the elevation of the end of the field. Use of mini-basins can prevent this problem from occurring and problem fields can be corrected by being built-up.