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Industrial Hemp Planting and Production

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This informational sheet is for producers that are considering Industrial Hemp production on their land. The site where hemp will be grown should be selected at least two years ahead of the year of planting. The information being presented is focused on land that has been in continuous grass-legume vegetation such as hay fields or conservation reserve program (CRP) or reclaimed strip mine land.

Policies Affecting the Market for Industrial Hemp

Since 1937 *Cannabis sativa* has been a federally regulated Schedule I drug under the Controlled Substance Act, regulated by the Drug Enforcement Agency (DEA) (**www.dea.gov/druginfo/ds.shtml**). A distinction between use of *Cannabis sativa* for medical, recreational, and industrial purposes was made only recently when Section 7606 of the Agricultural Act of 2014 (the "Farm Bill") was created. This cleared a legal path for industrial hemp to be grown in three limited circumstances: by researchers at an institute of higher education, by state Departments of Agriculture, or by farmers participating in a research program permitted and overseen by a state Department of Agriculture (**nifa.usda.gov/industrial-hemp**).

In 2016 the DEA, U.S. Department of Agriculture, and the Food and Drug Administration (FDA) issued a joint statement detailing the guidelines for growth of industrial hemp as part of state-sanctioned research programs. Those guidelines state that hemp can only be sold in states with pilot programs, plants and seeds can only cross state lines as part of permitted state research programs, and seeds can only be imported by individuals registered with the DEA (**www.federalregister.gov/documents/2016/08/12/2016-19146/statement-of-principles-on-industrial-hemp**).

Hemp Production

Hemp is best adapted to well-drained soils with a pH between 6.0 and 7.0. Hemp does not grow well on wet soils or those with a heavy clay content. Hemp is sensitive to soil crusting and soil compaction, which can occur on heavy clay soils. Ideally, hemp should be planted in May to early June in most areas of West Virginia. Some Canadian varieties are short season and could be planted through mid- to late June and still mature before frost. Hemp is a short-day plant and will only begin to mature when day length is less than 12 hours of sunlight. Hemp grown for seed is generally grown with medium to shorter varieties. Under current law, varieties must be sourced from other countries since shipment of seed between states is not permitted. Varieties that have low THC

levels must be selected. In West Virginia and many other states, the level of THC in industrial hemp must be under 0.3 percent. Most industrial hemp seed sources have tested their varieties to meet this requirement. Varieties come in various heights, including those that are medium height (6–7 feet tall), semi-dwarf (4–5 feet tall), and dwarf (3–4 feet tall). In the United States, medium to taller varieties are preferred because there are no herbicides labeled for hemp.

Site Selection

It is best to select sites that have been in grass-legume fields or vegetated reclaimed strip mine land because a good soil is needed for hemp seeding and growth. Sites with extensive erosion or large areas of bare ground should not be used for hemp production. Such grass-legume fields have had time to condition the soil with organic matter, which aids in developing good soil structure and water infiltration, and have had lower inputs of fertilizers and pesticides. The protective vegetative cover from a grass-legume mixture has also provided forage production and wildlife habitat.

It is best to select sites that have been in grass-legume fields.

As one begins to convert the grass-legume stand to crop production (in this case, hemp), proper planning and good management practices need to be sustained. A cropping system must be installed that will minimize the impacts to soil quality and maintain soil productivity. Here are some items to consider:

- Planting systems for each crop
- Soil fertility concerns (nutrient management planning)
- Protection of unique or sensitive areas (some areas can be planted with a crop while others should be left as grass-legume cover)
- Hydrologic considerations (runoff, infiltration, high water table, flooding)
- Special precautions such as stream buffers, surface water channels, wells, etc.

Depending on the planting system, soil erosion rates can increase when fields with steep, sandy or silty soils that may be highly erodible are cropped, compared to land maintained in a grass-legume sod. Exposing the soil to the erosive forces of wind and water when fields are returned to cropland seriously deteriorates the soil's ability to function.

Soil loss rates depend on the crop rotation, planting system, tillage, and crop residue left on the soil surface. Soil loss and deterioration can be greatly reduced by the use of conservation measures such as diverse crop rotations that include different crop types, cover crops and/or forages, reduced tillage systems, or smaller tilled areas. In some farm systems, cover crops are planted as a transition crop from the grass-legume sod to cropland. Cover crops can be used for a cash crop, forage or hay, green manure, or as a pest, nutrient or residue management strategy.

Plant an annual crop in the field to begin conversion to a cropping system.

Consult your local County Extension Agent or NRCS staff to find a crop rotation that controls soil erosion and benefits soil quality. Conservation tillage is defined as any tillage and planting strategy or technique for establishing crops in the previous crop's residues, which are purposely left on the soil surface. Generally, conservation tillage is any tillage/planting system which leaves at least 30 percent of the tilled surface covered with crop residue after planting has been completed. Research indicates that soil under a grass-legume sod results in significant soil quality improvements, namely in organic matter levels, aggregate stability, total pore space, and soil infiltration rates. These improvements result in soil that is in better condition to grow plants. Soils covered in grass-legume sods are ideally suited for a no-till system because they have the needed physical, chemical and biological qualities that will support successful no-till systems. If tillage is used, it should be restricted to the first year, and only involve implements (such as harrows, blade/roller, aerator, etc.) that lightly disturb the top few inches of soil and level rough areas in the field. Conventional tillage requiring several operations can destroy many of the soil quality improvements gained under grass-legume sod during conversion to cropland in one year.

It is crucial to know the current soil fertility levels before planting. Soils under long-term perennial vegetation are much different than soils that have been cropped regularly over the last decade. Soil tests to determine fertility should be completed before fields are returned to production, allowing ample time to schedule and apply lime and fertilizer required for planned crops. In areas where soil test nitrogen levels are low, consider applying starter fertilizer at planting. Consider the use of annual legumes as a cover crop prior to the cash crop year. These plants have a low C:N ratio and fix atmospheric nitrogen that is readily available to succeeding crops.

For a beginner, this process is suggested:

- Year One – Extract soil samples from prospective fields and follow the recommendations for applying nutrients and lime.
- Spring of Year One – Plant an annual crop(s) in the field(s) to begin the conversion to a

cropping system.

- Fall of the Year One – Work the annual crop into the soil as green manure and plant a winter cover crop mix on the field.
- Spring of Year Two – Seed the hemp crop either No-till or reduced tillage into a rolled/crushed cover crop, or light tillage soil.

By following these recommendations, hemp seeding and establishment will be enhanced. Hemp grows very fast and, within a few weeks, the plant will be several feet high. Weeds may be prominent but the hemp will overtop the weeds and shade them out after a month or two of growth.

Seed the hemp crop either no-till or reduced tillage into a rolled/crushed cover crop, or light tillage soil.

Weeds may be prominent but the hemp will overtake the weeds and shade them out after a month or two of growth.

Hemp Production for Seed

Hemp for seed can be planted in rows, like corn, or with a grain drill, like a small grain. Because there are no herbicides currently labeled for use on hemp, hemp grown in rows will require some mechanical weed control. Hemp can also be grown in a tilled seedbed similar to that prepared for forage crop establishment: firm, level, and relatively fine. It can also be established with no-till methods using burndown herbicides to control existing weeds. Planting rates for industrial hemp depends on the variety, but in general seeding rates from 25 to 35 pounds per acre are recommended. Planting depth should be ½ to ¾ inch. A dense, drilled stand should provide some control of weeds.

Fertilizer requirements are best determined by a soil test. The Agricultural Analytical Services Lab at Penn State has developed fertilizer recommendations for hemp. In a soil with optimum levels of phosphorus (P) and potassium (K), recommendations for a crop with a 1,500-pound yield potential would be 150 pounds of nitrogen (N), 30 pounds of phosphate (P_2O_5), and 20 pounds of potash (K_2O).

Industrial Hemp Grain Production Budget

Estimated costs per acre, conventional tillage, Pennsylvania, 2018

Item	Quantity	Unit	Price	Total	Your Estimate
Variable Costs					
Custom operations					
Soil test	1.0	acre	$2.00	$2.00	
Combine small grain	1.0	acre	$33.10	$33.10	
Grain hauling	320.0	bushel-mile	$0.04	$12.80	
Fertilizer/soil amendment					
Lime and spreading	0.5	ton	$26.00	$13.00	
Nitrogen (N)	150.0	pound	$0.24	$36.00	
Phosphorus (P)	30.0	pound	$0.30	$9.00	
Potassium (K)	20.0	pound	$0.23	$4.60	
Other					
Industrial hemp registration fee	1.0	acre	$20.00	$20.00	
Industrial hemp THC testing fee	1.0	acre	$2.00	$2.00	
Drying industrial hemp seed	32.0	bushel	$0.46	$14.72	
Seed					
Industrial hemp seed	35.0	pound	$2.50	$87.50	
Rye cover crop seed	2.0	bushel	$7.50	$15.00	
Operator labor					
Hour	1.2	hour	$17.00	$20.40	
Diesel fuel					
Tractors	5.7	gallon	$2.80	$15.96	
Repairs and maintenance					
Implements	1.0	acre	$7.01	$7.01	
Tractors	1.0	acre	$5.19	$5.19	
Interest on operating capital	1.0	acre	$5.95	$5.95	
Total Variable Costs				***$304.23***	
Fixed Costs					
Implements	1.0	acre	$16.44	$16.44	
Tractors	1.0	acre	$12.59	$12.59	
Land charge	1.0	acre	$100.00	$100.00	
Total Fixed Costs				***$129.03***	
Total Costs				**$433.26**	

Grain Yield Price Sensitivity

Price per pound	Yield (pounds per acre)				
	1,000	1,200	1,400	1,600	1,800
	Return per acre				
$0.50	$74.56	$170.65	$266.74	$362.83	$458.92
$0.60	$174.56	$290.65	$406.74	$522.83	$638.92
$0.70	$274.56	$410.65	$546.74	$682.83	$818.92
$0.80	$374.56	$530.65	$686.74	$842.83	$998.92

Note: a bushel of industrial hemp seed weighs approximately 44 pounds.

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