The Agronomic and Economic Performance of Canola as a Biofuel Feedstock in the Northeast U.S.

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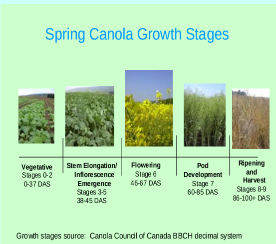
Canola in bloom at Rock Springs, PA, variety trials

Biodiesel production is increasing in Pennsylvania and demanding vegetable oil feedstock, primarily from soybean. Canola could be an alternative to soybean; it has double the oil content of soybean and its meal by-product is an excellent high-protein livestock feed. Canola oil is also regarded as superior to soy-based biodiesel because of its lower pour point and better stability. Penn State has conducted variety trials in Centre county (winter canola) and in multiple locations (spring canola) to assess crop performance and the economic viability of both winter and spring canola .

Winter canola has similar growth stages as spring canola, but has a long period of winter dormancy. The spring canola crop cycle is about 100 days. winter canola requires more than 250 days from fall sowing to summer harvest. In trials conducted at Penn State, three replications of randomized, complete block plots were used to evaluate canola field production. Production methods, including field pre-treatment and seed bed preparation, fertilization, pesticide treatments and harvest methodology were consistently applied. Data on plant germination, vigor, winter survival, height and bloom timing and yield were collected. SAS was used to compute mean and least significant differences among varieties and locations.



Spring canola is planted in April and harvested in July.

Spring canola trial plots, left, at the vegetative plant stage.

Winter canola in bloom, below, left, at Rock Springs trials. Spring canola in pod, right at Landisville trial. In early July, winter canola is harvested; for spring canola, harvest is usually late July. The combine harvested Farm Services fields in July, 2007. Top grade canola oilseed is dark in color, dense and shiny, as shown below.

Winter Canola Evaluation

Penn State has participated in the National Winter Canola Variety Trial for several years. This trial is organized and run by the Kansas State University; it evaluates more than 35 winter canola varieties across 25+ locations from the deep South to the high plains of Wyoming. In Pennsylvania, the varieties have averaged about 50 bu/acre, with the highest yielding varieties exceeding 60 bu/acre. Plant winter survival could be as low at 40% of a good fall stand before it affects eventual yield. Consistent moisture and moderate temperatures are more predictive of yield than is the survival rate. Oil yields have ranged from 38-42% of the seed weight.

Table 1. Yield results from high-yielding varieties in the National Winter Canola Variety Trials

	2006			2007		
Variety	(lbs/acre)	(bu/acre)	w sur (%)*	lbs/acre	bu/acre	w sur (%)*
Abilene	3286	65.7	93	2133	42.7	82
Virginia	3215	64.3	93	2155	43.1	88
Jetton	3056	61.1	92	2509	50.2	73
KS3074	3015	60.3	97	2710	54.2	87
Baldur	2984	59.7	95	3158	63.2	80
Kronos	2983	59.7	93	2453	49.1	70
KS3067	2955	59.1	97	nt	nt	nt
KS3254	2872	57.4	97	2877	57.5	73
KS3108	2868	57.4	95	2294	45.9	73
VSX-2	2994	59.9	92	nt	nt	nt
Complete Trials						
Mean	2629	52.6	95	2245	44.9	73
CV	13		3	26		18
LSD (.05)	555		NS	930		22

*winter plant survival in percent of fall stand
"nt" means not evaluated in the 2007 National Winter Canola Variety Trial

In Illinois and Ohio , some of these varieties have yielded more than 80 bu/acre. In the South and Southern Mid-west, yields are much lower (<20 bu/acre) due primarily to high temperatures and low precipitation during the critical bloom and pod-filling time.

Spring Canola Evaluation

Spring canola trials were conducted in 2007 in three climate zones across the State to evaluate the effect of temperature on canola yields and oil content. The trial locations are shown in Fig. 1.

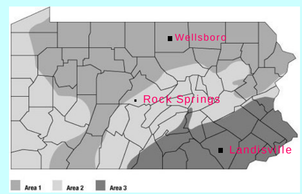


Fig. 1. Small grains zones in Pennsylvania

Temperatures during the growing season in the Rock Springs and Landisville locations were higher than those in Wellsboro, as shown in Fig. 2, right. Maximum daily temperatures exceeded 90º F on 22 days in Landisville, 8 days in Rock Springs and 0 days in Wellsboro. These differences were the principle reason for the yield differences shown in Table 2, below.

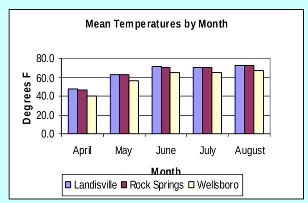


Fig. 2. Spring canola mean temperatures by location.

Table 2. 2007 spring canola trial results

			Yield in lbs/acre by location			
Brand	Variety	Type/Trait	Landisville	Rock Sprg	Wellsboro	Combined
Croplan	HyCLASS 601	hyb, non	1125	1220	1320	1209
Croplan	HyCLASS 410	hyb, RR	1092	1455	1742	1462
Croplan	HyCLASS 712	syn, RR	1206	1646	2017	1623
Croplan	HyCLASS 924	hyb, RR	1271	1832	2167	1756
Croplan	Crosby	OP, RR	1273	1960	2331	1855
Croplan	Rugby	OP, RR	1244	1735	2182	1720
Croplan	InVigor 5550	hyb, LibLink	1225	1877	2584	1895
Croplan	Python	hyb, Clearfield	1223	1652	1808	1561
Monsanto	Hyola 357	hyb, RR	1425	1696	2767	1963
Monsanto	SW Patriot	syn, RR	1442	1568	2200	1737
Monsanto	IS7145	hyb, RR	1424	1958	2689	2024
Monsanto	DKL 38-25	hyb, RR	1435	2075	2446	1985
		Mean	1281	1723	2200	1730
		CV	23.9	9.2	14.2	12.8
		LSD (0.05)	519	277	527	362

Notes: Within location, the highlighted yields are not signficantly different.

Spring canola trial results show that each location's average yield was significantly different from the others. The highest yielding varieties were consistently high across locations. In Landisville, all varieties were affected by high temperatures, and no one variety performed better than the others under these conditions. Oil yield averaged 44% at 4% seed moisture, with no significant difference across locations.

Canola Economic Evaluation

Going into production with a new crop means managing both production and market risks. The new crop must be profitable enough to compensate the farm producer for taking these risks. With winter canola, the crop competes with winter wheat. Spring canola competes primarily with soybean.

Production costs for all crops can be estimated with enterprise budgets, such as have been developed in the Penn State Agronomy Guide. The cost categories and their relative importance are shown in Fig. 3 for canola, soybean and winter wheat, based on 2008 local prices, including custom harvest pricing. Winter canola costs are higher than spring canola because winter canola requires more fertilizer for fall establishment. Soybean fertilizer costs are lowest because soy does not require added nitrogen. The higher soybean seed cost somewhat offsets the lower fertilizer cost. Other costs are fairly similar across crop type.

Total costs per acre for each crop are estimated at:

Soybean	$175.03
Spring Canola	213.36
Winter Canola	235.63
Winter Wheat	237.77

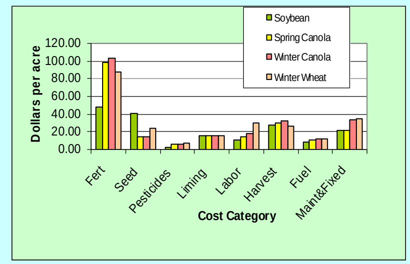


Fig. 3. Production cost categories and their value per acre

In winter wheat, the sale of straw at is often credited against the cost of growing the crop in PA. This credit, about $150/acre, reduces total costs to $87.77 per acre.

The difference between market price and production cost is considered to be the profit per acre. In Fig. 4, the arrowed lines indicate when profit per acre is equivalent between soybean and spring canola (pink) and winter wheat and winter canola (blue). Winter wheat without the straw credit is shown in green. Soybean and winter wheat bushels are based on historic state average yields: 45 bu/acre for soybean and 53 bu/acre for winter wheat.

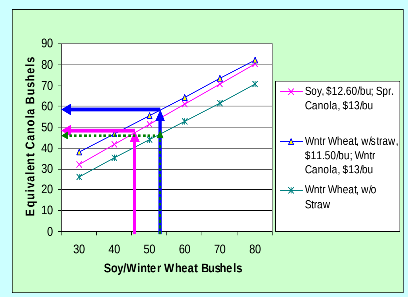


Fig. 4 . Profit equivalents in bushels of canola for bushels of soybean and winter wheat.

In conclusion, spring canola yields would have to be near 50 bu/acre for equivalence to soybean; winter canola yields should be 60 bu/acre for equivalence to winter wheat plus straw at the prices shown.

Further study More multiple location trials of winter canola commercial varieties should be conducted and spring canola trials continued to further understand variety performance by location. Oil quality tests for biodiesel and other industrial uses would help to estimate the value of canola oil produced in the Northeast U.S. for these uses.

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