Determining optimum agronomic practices to maximize productivity of canola-quality oriental mustard (*Brassica juncea*).

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Introduction

Few crop species are suitable for northern Idaho growers to include in rotation with small grain cereals. *Brassica* crops such as winter and spring canola and rapeseed have long been grown in this region, albeit on a relatively small acreage basis. Similarly, yellow mustard (*Sinapis alba*) has recently proven to be a valuable rotation crop. Wheat yields after canola, rapeseed and yellow mustard have been shown to be favorably high compared to monoculture cereal production. These crops are high in plant biomass that adds to the soil organic matter and improves water holding capacity. In addition, these crops break disease cycles and they produce allelochemicals may that further reduce soil-borne diseases.

Over the past 10 years, a number of new winter and spring canola, spring rapeseed, and yellow mustard cultivars have been released and are now grown commercially in northern Idaho. Several studies have been conducted over this period to examine optimum growing conditions including herbicide efficacy studies, studies examining the effects of variable nitrogen and other nutrients, insect damage and insecticide efficacy studies, etc., which have greatly added to the yield potential and sustainability of these crops in rotation with wheat and barley.

Recently, traditional breeding efforts in Canada and Australia have resulted in the development of oriental mustard (*B. juncea*) with canola-quality seed oil and seed meal. The University of Idaho obtained some of these breeding lines several years ago and field tested two of them in this study to assess local adaptability. The USDA will likely grant "canola status" to these new canola-type mustards within the next few years. This could increase the acreage of canola in the region by expanding production into drier areas. In addition, greater flexibility in rotation options would be available with additional crop species other than the canola species available at present.

Unlike their *Brassica* and other mustard relatives, oriental mustard crops are new to this area, and as yet little research has been directed towards determining optimum nitrogen management and seeding rates for maximum crop productivity and seed quality. This project will help to determine optimum agronomic practices to maximize productivity of canola-quality oriental mustard *B. juncea*, so that when this status is granted we will have prior knowledge on how to best grow these new canola lines under Pacific Northwest conditions.

The objective of this study is to determine the effect of varied nitrogen rates and seeding rates on productivity and quality of canola-quality oriental mustard cultivars in the Pacific Northwest.

Materials and Methods

The effects of varying available nitrogen rate (5 rates) and seeding rate (3 rates) on two canola-quality *Brassica juncea* cultivars ('Arid' and 'Dahinda') and the condiment oriental mustard cultivar 'Pacific Gold' was determined at two locations and two planting dates in conventional and direct seeding systems in northern Idaho and in Pendleton, Oregon during 2005.

Prior to planting, soil samples were taken to determine base nitrogen level. Nitrogen treatments were added such that total available nitrogen was approximately 75, 103, 131, 159, and 187 kg N/hectare. The experimental design of the complete trial at each site was a strip-split plot design with four replicates (i.e. four cultivars x five nitrogen levels x three seeding rates x three replicates resulting in 180 plots per seeding date per site). Plant growth was monitored throughout the growing season and the variables recorded included plant stand counts, flower start date, and plant height at maturity. Flower start date was not recorded in Pendleton. At harvest, seed from each plot was harvested and the seed weighed. A sub-sample from each plot was removed, and that seed was used to determine oil content and seed size. At the time of writing, seed quality traits were still being evaluated in the laboratory.

Results

Averaged over all planting dates, sites, nitrogen application rates, and seeding rates, Pacific Gold produced 1,558 kg/hectare, while the yield of the canola-quality cultivars, Arid and Dahinda, was 1,025 kg/hectare, which was significantly less than the condiment mustard (Table 1). The canola-quality cultivar yields were 34% lower than that of Pacific Gold. Arid and Dahinda seedling emergence was poor compared to Pacific Gold, and this resulted in significantly reduced seedling stand counts with Arid being significantly less than Dahinda. Arid flowered ½ day later than Pacific Gold and Dahinda, and Arid was significantly shorter than Pacific Gold and Dahinda.

Table 1. Seed yield, plant stand counts, days from planting to 50% bloom, and plant height of four cultivars averaged over all treatments.

Cultivar	**Seed yield**	**Plant stand**	**Days to Flower**	**Plant height**
	-- kg/ha --	**- plants/m -**	**--- days ---**	**-- cm --**
Pacific Gold	1,558 [a]	30.5 [a]	51.1 [b]	132 [a]
Arid	1,039 [b]	26.3 [c]	51.7 [a]	120 [b]
Dahinda	1,011 [b]	24.1 [b]	51.1 [b]	131 [a]
Mean	1,203	27.0	51.3	128
LSD 5%	42	1.8	0.13	1.8

Means within columns with different superscript letter are significant (P<0.05).

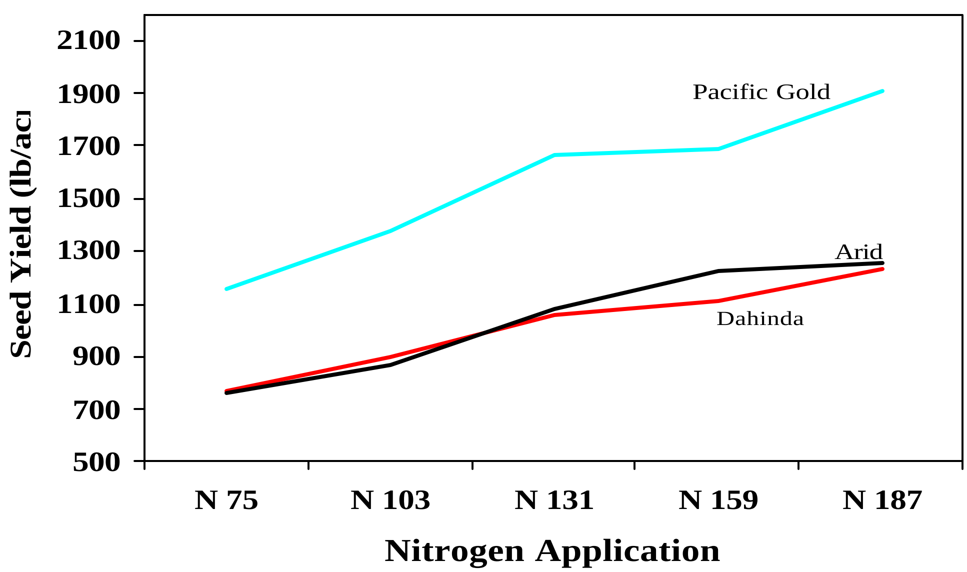
Increased nitrogen application had a significant impact on seed yield (Table 2). The relationship between nitrogen applications and seed yield was significantly linear for all cultivars. Pacific Gold, however, had a greater nitrogen response than Arid or Dahinda (Figure 1). Increasing the nitrogen application rate by 1 kg/hectare resulted in a 6.5 kg/hectare seed yield increase in Pacific Gold, while 1 kg/hectare increase in nitrogen application produced only a 4.8 and 4.1 kg/hectare yield increase in Arid and Dahinda, respectively. Increasing available nitrogen significantly affected stand counts and days to flower. As would be expected, increased nitrogen application resulted in significantly taller plants.

Table 2. Seed yield, plant stand counts, days from planting to 50% bloom, and plant height after application of five nitrogen rates averaged over all treatments.

Nitrogen Rate Applied	**Seed yield**	**Plant stand**	**Days to Flower**	**Plant height**
	-- kg/ha--	**- count/m -**	**--- days ---**	**-- cm --**
0 kg N	890 ^{d}	26.6 ^{ab}	51.6 ^{a}	116 ^{d}
28 kg N	1,046 ^{c}	27.7 ^{ab}	51.2 ^{ab}	124 ^{c}
56 kg N	1,266 ^{b}	26.0 ^{b}	51.2 ^{ab}	150 ^{b}
84 kg N	1,340 ^{b}	28.6 ^{a}	51.2 ^{b}	132 ^{ab}
112 kg N	1,458 ^{a}	25.8 ^{b}	51.2 ^{ab}	135 ^{a}
Mean	1,200	26.9	51.3	127
LSD 5%	80	2.0	.39	4.1

Means within columns with different superscript letter are significant ($P<0.05$).

Figure 1. Yield response of four cultivars to increased available nitrogen.



Yield did not change significantly when seeding rate was decreased from 11.8 kg/hectare to 5.9 kg/hectare (Table 3). As expected, increased seeding rates were associated with higher seedling stand counts. Greater inter-plant competition at the higher seeding rates likely caused the earlier flowering and shorter plants seen in those treatments.

Table 3. Seed yield, plant stand counts, days from planting to 50% bloom, and plant height of three seeding rates averaged over all treatments.

Seeding rate	**Seed yield**	**Plant stand**	**Days to Flower**	**Plant height**
	-- kg/ha --	**- count/m -**	**--- days ---**	**-- cm --**
5.9 kg/ha	1,1186	18.1 [c]	51.6 [a]	131 [a]
8.8 kg/ha	1,222	28.0 [b]	51.2 [b]	128 [b]
11.8 kg/ha	1,194	34.7 [a]	51.1 [b]	124 [c]
Mean	1,201	26.9	51.3	128
LSD 5%	n.s.	1.8	0.13	1.8

Means within columns with different superscript letter are significant (P<0.05).

Only data from the conventionally tilled sites were included in the planting date analysis. Seed yields from both sites were statistically similar at the p<0.05 level but were significantly different at the P<0.10 (Table 4). Averaged over all cultivars, seed yield from the early plantings was 1,494 kg/hectare, while the yield in the later plantings was 17% lower. Later planting was related to significantly lower seedling stand counts, which was likely due to a heavy rain shortly after the late planting date that caused soil crusting and appeared to decrease plant emergence. Later plantings had fewer days from bloom to maturity compared to the early plantings, which may have been caused by a day length response and/or greater heat and drought stress during the early stages of flowering.

Table 4. Seed yield, plant stand counts, days from planting to 50% bloom, and plant height from early and late planting averaged over all conventional till treatments.

Planting date	**Seed yield**	**Plant stand**	**Days to Flower**	**Plant height**
	--- kg/ha ---	**- count/m -**	**--- days ---**	**-- cm --**
Early	1,494 [a]	35.3 [a]	54.9 [a]	133
Late	1,242 [a]	25.2 [b]	47.4 [b]	125
Mean	1,368	30.3	51.2	129
LSD 5%	253	3.6	0.24	n.s.

Means within columns with different superscript letter are significant (P<0.05).

Potential benefits and impacts

Given the wide diversity of environments that exist in the Pacific Northwest, utilizing all canola-producing species will likely be necessary if a sound canola industry is to be developed. This is the first study evaluating the newly developed canola-quality *B. juncea* cultivars in the region. Their performance in these trials was not as good as the condiment type grown for comparison. However, industry and grower interest in Pacific Gold in northern Idaho has escalated dramatically since its release in 2001. Most of this interest has stemmed from the high yield potential of this cultivar throughout the region. The true potential of canola-quality mustard cultivars may be a few years from realization but will likely attract the most attention in the dryland regions where canola is not successful. This is the first research that has investigated the effects of planting date, seeding rate or nitrogen on productivity of *B. juncea*. Making strong recommendations or conclusions based on a single year of results is difficult, but when combined with results from 2004 and upcoming results in 2006, initial guidelines can be established. In addition, we hope to continue this type of agronomic research in future years.

Results from this study are posted on the University of Idaho *Brassica* Breeding website <http:/www.ag.uidaho.edu/brassica/>. With further years of experimentation this information will be available to maximize productivity and grower profitability in growing mustard crops.

Publications

Determine optimum agronomic practices to maximize productivity of oriental mustard (Brasscia juncea L.) in the Pacific Northwest. 2005. J. Olmstead, J. Brown, and J.B. Davis. American Society of Agronomy 98th Annual Meeting. November 6-10, 2005.

Determine optimum agronomic practices to maximize productivity of oriental mustard (Brasscia juncea L.) in the Pacific Northwest. 2005. J. Olmstead, J. Brown, J.B. Davis, and D. Wysocki. Western Society of Crop Science Annual Meeting. June 19-22, 2005.

Determining optimum agronomic practices to maximize productivity of canola-quality oriental mustard (*Brassica juncea*). 2005. J. Olmstead, J. Davis, J. Brown, and D. Wysocki. University of Idaho Canola, Rapeseed and Mustard Program website <http:/www.ag.uidaho.edu/brassica/.>