Determine optimum agronomic practices for Oriental mustard (*Brassica juncea* L.) in the Pacific Northwest

Jeannie Olmstead, Jack Brown and Jim B. Davis
University of Idaho, Moscow, Idaho 83844-2339

ABSTRACT

Oriental mustard has recently been introduced as a rotation crop in the Pacific Northwest. However, no research has been conducted to determine optimum nitrogen management, seeding rates, or planting dates for this crop in the region. In 2004 and 2005, two locally developed cultivars ('Pacific Gold' and 'Kodiak') and two canola-quality cultivars developed in Canada ('Arid' and 'Dahinda') were evaluated at two locations with two seeding dates, five nitrogen rates, and three seeding rates. Pacific Gold produced the highest yield, followed by Kodiak. All cultivars responded to increased nitrogen, although greatest yield response was by Pacific Gold. Earlier planting produced increased yields. The intermediate seeding rate yielded significantly higher than the low rate, but was not significantly different from the highest rate.

INTRODUCTION

Wheat, both winter and spring planted cultivars, is the primary crop grown in the Pacific Northwest. There are few profitable alternative crops for this region. Winter and spring rapeseed, canola and yellow mustard are Brassicaceae crops that have been investigated as rotation options and are currently grown on small acreages. Oriental mustard has been successfully grown in many areas of Canada and in exploratory trials has been shown to be a profitable option for the Pacific Northwest. It has been shown that, following rapeseed, canola or yellow mustard, wheat yields are favorable compared to those from monoculture wheat. Brassicaceae crops are high in biomass, help break up disease cycles prevalent in monoculture and are thought to release allelochemicals that may further reduce the presence of weeds and disease causing organisms in the soil. When canola, rapeseed and yellow mustard were introduced to the region, studies were conducted to determine the maximum yield potential by investigating optimum nitrogen availability, planting date, seeding rate as well as other nutrients, potential insect damage and resistance and weed competition. As Oriental mustard appears to be a profitable alternative crop for the Pacific Northwest, this experiment is being conducted to study the effects of available nitrogen rates, seeding rates, and planting date on the yield potential and quality of four cultivars at two different locations.

MATERIALS AND METHODS

The experimental design is a split-split plot with main plots being nitrogen rate, subplots being the cultivars and sub-subplots as the seeding rates. The experiment has been conducted over two years (2004 and 2005) at two locations, Moscow, Idaho, and Genesee, Idaho. The early seeding date was planted as soon as weather permitted with the late date being approximately 14 days later. Four cultivars were used, two that were developed at the University of Idaho ('Pacific Gold', a yellow seeded Oriental mustard and 'Kodiak', a brown seeded Dijon-type mustard) and two canola quality *B. juncea* developed in Saskatchewan, Canada ('Dahinda' and 'Arid'). Nitrogen was applied as urea (46% N) at rates of 0, 28, 56, 84 and 112 kg available nitrogen per hectare. A base fertility level was determined using soil tests so that in the top two feet there was approximately 73 kg of available N per hectare. Seeding rates of 5.9, 8.8 and 11.8 kg ha^{-1} were planted. Plots were 1m by 4.9m in size. Nutrients other than nitrogen were supplied at levels recommended for canola production. Weed and insect populations were controlled as necessary during the growing season. Data was collected on the number of plants per meter row, days to flower, seed yield per plot, seed oil content and seed size.

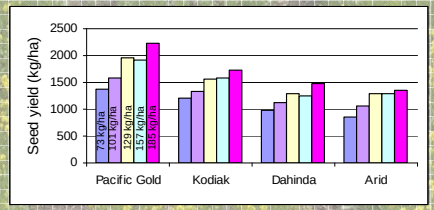

Figure 1. Yield response of cultivars to increasing available nitrogen

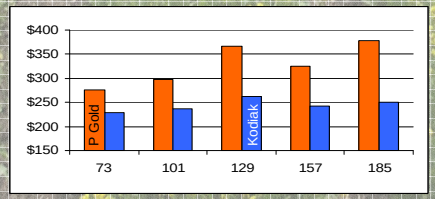

Figure 2. Profit margin of Pacific Gold and Kodiak over five available nitrogen rates

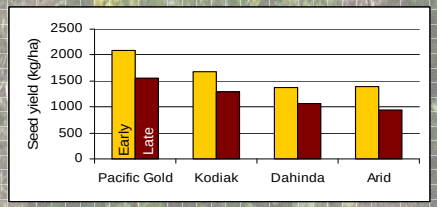

Figure 3. Yield of four cultivars from early and late planting dates.

RESULTS AND DISCUSSION

Analyses over sites and years showed that the main effects of site, planting date, nitrogen rate, cultivar, and seeding rate were all significant for seed yield. Averaged over cultivars, seed yield was significantly linear with increasing nitrogen (Figure 1). There were, however, significant interactions between cultivar and nitrogen and between planting date and nitrogen. Using linear regression analysis, Pacific Gold seed yield increased by 9.3 kg ha^{-1} for each additional kg of available nitrogen. In contrast, Kodiak seed yield increased by only 5.9 kg ha^{-1}, while Dahinda and Arid, the canola quality cultivars, increased by 5.6 and 5.2 kg ha^{-1}, respectively, for each additional kg of available nitrogen. Despite a significant interaction between nitrogen and planting date, increasing nitrogen from lowest to highest resulted in a 51% and 59% yield increase in the early and later plantings, respectively.

From a purely analytical sense, analyses of harvestable seed yield is highly important. However, with regards to productivity, seed yield increases must be weighed against increased grower costs. For example, is the increase in seed yield associated with increasing nitrogen justified given the now high costs of nitrogen fertilizers. In the analyses of profitability harvested seed is valued at $0.25 kg^{-1} (obtained from a local grower cooperative) while nitrogen in the form of liquid anhydrous (NH_3) is $0.97 kg^{-1} N. Assuming all other costs remain constant, 112 kg N ha^{-1} would be the most profitable nitrogen rate for the highly responsive cultivar Pacific Gold. In contrast, the intermediate rate of 129 kg N ha^{-1} would is most profitable for Kodiak, which did not respond as highly to increasing nitrogen (Figure 2).

The planting date x cultivar interaction was significant (Figure 3). All cultivars, however, had highest yield from the early planting compared to the later date. The cultivar Arid was most sensitive to planting date, and had a 32% yield loss when planted late, compared to an average of 24% loss for the other cultivars. The late planting had a shorter vegetative period before flowering combined with higher temperatures during flowering and seed full, which is most likely the major cause of the decreased yields.

CONCLUSIONS

Preliminary data supports high nitrogen application to responsive cultivars like Pacific Gold but not to lower yielding cultivars. Growers would be advised to seed at rates higher than 6 kg ha^{-1}. Early planting is advised, although the later planting did produce acceptable yields. In addition, the same trend is also true for spring wheat, which has a greater potential profit margin. Therefore, producers will likely plant their mustard crops later than the earliest date used for this study so that they can plant their major cash crops first.