Agronomic management practices to improve yield and oil content in winter Canola

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Abstract:

Biofuel is the logical alternative fuel source that can power the American economy. Biofuels burn clean and emit less greenhouse gases than gasoline (DOE, 2008). Biofuel production and consumption result in positive net energy and greenhouse gas emissions which will save the environment in the near future (Horne et al., 2003). Dependence on corn for ethanol production has been increasing and might reach its maximum potential by 2010, and to improve the potential of corn production, fertilizer use might increase which will require conventional energy consumption to produce fertilizers and pesticides, hence growing promising alternative biofuel crops like canola is almost imperative (Heffer, 2007). Canola is a winter annual crop, suitable to be grown in North Carolina. Information on nutrient requirements of canola on Piedmont soils is very limited. In addition, data on suitable varieties, crop rotation and pest control is not available. A three year experiment is set up to study the nutrient requirements of canola for optimum yield realization and to improve the oil content in the seeds. Biofertlizers are included in the treatments specifically targeting at improving the oil content. Four fertilizer treatments (No fertilizer, 100 % RDF*, 50% RDF* + Biofertilizer and 100 %RDF* + Biofertilizer) are evaluated in a split-split-plot design. Chlorophyll readings are recorded and plant tissue and soils samples are collected at flowering and maturation stages to determine the nitrogen availability in the soil and uptake by canola so we can manage the nutrient supply efficiently to obtain maximum yield.

*RDF – Recommended Dose of Fertilizer

Introduction:

International Energy Agency (IEA) projected that 14 percent of energy consumed worldwide was derived from biomass (IEA, 1998). Available biomass potential as an energy source is vastly under exploited in most of the world except in Asia where usage of biomass for bioenergy exceeds their potential (Parikka, 2004). In 2007, North Carolina state used about 5.6 bi gallons of petroleum-based liquid fuels, all of which were imported (North Carolina's Strategic Plan for Biofuel Leadership, 2007). The Fueling North Carolina Future committee envisioned that by 2017, 10% of liquid fuels sold in North Carolina will come from biofuels locally grown and produced. In order to achieve a goal of this magnitude, focus should be on improving our biomass production by adopting improved management practices. Canola (Brassica napus) is a crop that is widely grown for its oil for cooking and to produce biodiesel, but so far it is not the case in North Carolina. Canola seed has high oil content, which can be used for biodiesel production as well as for cooking oil.

Rationale:

Studies in Italy found that canola is more preferable biodiesel source than soy, sunflower and jatropha in terms of yield and quality (Baldini et al., 2008). Biofuel produced from canola is studied and recommended to be used in aviation industry in either their pure form or mixed with petrol fuels (Pagowski, 2001). Biodiesel from canola has better cold flow (operates engines at low temperatures) and a high cetane number (higher the cetane number quieter is the engine operation) than biodiesel from soybean or petroleum based diesel (George et al., 2008). Information on nutrient requirements of canola on Piedmont soils is very limited.

Materials and methods:

Experimental design and Statistical analysis: Canola seeds were sown in early October, 2009. Two varieties (Virginia and DKW 46-15) with four fertilizer treatments were grown in a Randomized Block Design (RBD) with 2X4 factorial (2 varieties, 4 treatments) arrangement. Bio-fertilizer treatment is done with Surya Organics products. Canola is harvested, seed is separated and oil is extracted with a OEKO TEC grinding mill imported from Germany. Crude fat determination is done by Soxhlet method. Data is analyzed (Analysis of variance (ANOVA)) using Statistical Analysis System (SAS) software.

Fig 1 (a). Canola at flowering stage, (b) Canola at harvesting stage when majority of the pods turn brown, and (c) Canola oil extraction equipment from OEKO TEC, Germany.

Results and Discussion:

- Variety -2 (DKW 46-15) performed better than Variety -1 (Virginia) in the Central piedmont area (Guilford county, NC) (Table 1).
- Yield of both varieties is on par with the recorded average yield of commercially available canola varieties in North Carolina (Table 2) .
- Oil percentage is consistently higher in Virginia variety for all treatments.
- T3 (50% RDF + BF) yielded more oil content in canola (Table 1). Increase in oil content can be attributed to reduced N fertilizer application. Higher N application increase protein content and reduces oil content.
- Significant increase in yield was not observed among the treatments, but T3 (50% RDF + BF) yields were on par with T2 and T4 which have 100% RDF which suggests that fertilizer use can be reduced by 50% when canola is grown with a combination of BF and inorganic nutrient source.

Table 1. Canola seed yield and oil content for Virginia and DKW 46-15 varieties in the Central piedmont area (2009-2010)

Treatment		Yield (bu/ac) Var-1 (Virginia)	Yield (bu/ac) Var-2 (DKW 46-15)	Oil % Var-1 (Virginia)	Oil % Var-2 (DKW 46-15)
T1	0% RDF	07	12	38	33
T2	100% RDF	16	22	34	32
T3	50% RDF + BF	18	19	38	34
T4	100% RDF+BF	21	21	37	32

bu – bushell (52 lb), ac – acre, RDF – Recommended Dose of Fertilizer, BF – Bio-fertilizer

Table 2. Performance of commercially available canola varieties grown at four research sites in North Carolina in the 2007/2008 season. (Reproduced from The North carolina Canola Production Guide, November 2008)

VARIETY PERFORMANCE					
	Carolina in the 2007/2008 season				
	Research Sites				
Canola Variety	Clayton	Fletcher	Plymouth	Reidsville	Average
	Yield (bu/acre)				
Hornet	12	24	20	12	17
Rally	10	24	17	19	17
HyClass107W	12	24	16	19	18
Sitro	15	24	19	15	18
Flash	15	24	19	16	19
DKW13-69	15	28	21	22	21
Sumner	13	25	20	30	22
Hybridstar	19	29	24	19	23
kadore	14	32	27	26	25
Satori	19	29	25	27	25
Virginia	19	29	26	28	25

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