Nutrient Uptake and Partitioning by Industrial Hemp

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Method

A commercial 160 acre hemp field in northwestern Manitoba near Dauphin was selected for the study. The soil was a moderately well drained Gilbert sandy loam. The field had previously been cropped to oats and alfalfa hay.

The cultivar USO 31 was seeded on May 12, 2007 at 35 lb/ac with a zero-till air seeder in 10’ wide rows with a 3’ wide seed spread. The previous fall 135 lb K₂O/ac was broadcast followed by 60 lb N, 33 lb P₂O₅ and 10 lb S/ac in a mid-row band at seeding. Combine harvest of the entire previous fall 135 lb K₂O/ac was broadcast followed by 60 lb N, 33 lb P₂O₅ and 10 lb S/ac in a mid-row band at seeding. Combine harvest of the entire field on September 19 averaged 950 lb/ac of clean seed.

Plants were sampled from a 3 row length on a 2-week schedule (see figures below) in a RCB sampling pattern with 2 replicates. Above-ground parts were sampled, partitioned, dried, chopped and ground for nutrient analysis by ALS Labs. Flower material was considered the reproductive portion of the head and the chaff after threshing the seed. The August 9 sampling had excessive leaf loss in handling and data is not shown here. Fallen leaves were captured for later sampling dates.

Primary nutrient uptake

Total nitrogen (N) uptake was 180 lb/ac with 36 lb N/ac in the grain.

• Maximum rate of N uptake was 6.0 lb N/ac/day during rapid vegetative growth in late July.

• Some 53 lb N/ac disappeared from vegetative tissue between flowering and maturing with 35 lb N/ac moving into the seed.

Total phosphorus (P) uptake was 42 lb P₂O₅/ac with 40% in the grain.

• Rate of P uptake was 1.4 lb P₂O₅/ac/day in late July and later accumulated in grain at 0.54 lb P₂O₅/ac/day.

The rate of potassium (K) uptake during vegetative growth in July was 5.4 lb K₂O/ac/day. The greatest K uptake was 188 lb K₂O/ac in late July at the start of flowering. By maturity, K content had declined by 59 lb K₂O/ac removed in the grain.

Secondary nutrient uptake

Total sulphur (S) uptake was 12.5 lb S/ac with 20% in the grain.

• Appeared to be translocated from leaves to the grain.

Calcium (Ca) uptake was greater than expected.

• Most Ca was present in leaves (53%), stem (33%) and flower (12%) with very little accumulation in the seed.

Greatest magnesium (Mg) uptake was 52 lb Mg/ac with 8% in the grain.

Discussion

The magnitude of nutrient uptake was similar to that observed in earlier Manitoba studies (1). The rapid hemp growth that occurred in July caused most nutrients to be taken up at high rates. Nutrient accumulation slowed after this period for a number of possible reasons:

• Male plants comprise about 10% of the population and they cease growth and senesce after pollination.

• Several days exceeding 30°C and low soil moisture occurred in early August leading to some lower leaf senescence. Not all senescing leaves may have been captured during our sampling.

• Stalk growth generally slows during flowering but resumes during seed development. Although the hemp crop takes up a considerable quantity of nutrients, most remain in the stalk owing to the low harvest index and a low amount is removed in grain (the exception being P). With the retting process in the field, the majority of the potassium taken up and apportioned into the stalk appears be leached out. This does have some agronomic implication as potassium is concentrated under swaths.

References


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