

Nutrient Uptake and Partitioning by Sunflowers in Manitoba

John Heard and Rob Park- Manitoba Agriculture, Food and Rural Initiatives John.Heard@gov.mb.ca



Background

Current interest in determining crop nutrient budgets requires crop advisers to rely on standard book values of nutrient uptake and removal. Usually little information exists on micronutrient uptake. This study was initiated to validate current nutrient values for sunflowers under Manitoba conditions.

Method

Whole plant sampling of commercial fields of sunflowers was done at several times during the 2005 growing season at 2 sites. A third site was sampled at harvest in 2006.

Sampling

Plants were sampled on a schedule according to 6 critical growth stages in a RCBD sampling pattern with 3 replicates. Above-ground parts were sampled, partitioned, dried, chopped and ground for nutrient analysis by AgVise Labs.

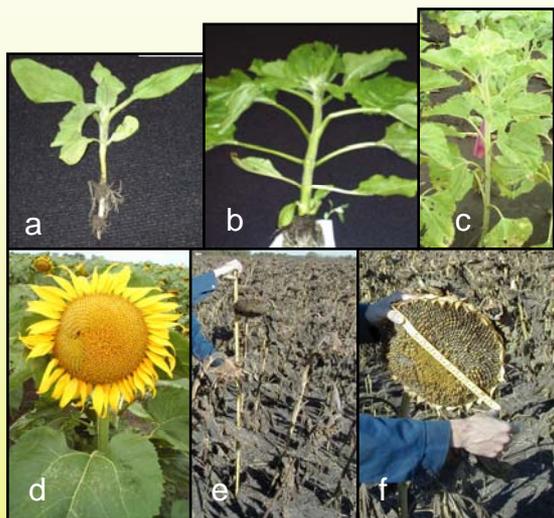


Figure 1. Sunflower sampling in 2005.:

- a - V4 on June 16
- b - V8 on July 4
- c - R1 stage, July 16
- d - R6 stage, August 10
- e - R9, September 26 at harvest
- f - R9, September 26 at harvest (Treherne site)

Growing season

- 2005 was near normal for GDD but 113% of normal precipitation with heavy June and July rainfall causing excess water stress at the poorer drained Carman site
- 2006 was 105% of normal GDD with only 50% of normal rainfall in the growing season

Yields

- Yields were very high at Treherne in 2005 (3772 lb/ac) and Carman in 2006 (3274 lb/ac) but were depressed at Carman in 2005 due to excess water stress (1473 lb/ac).

Nutrient Uptake and Partitioning

The following figures illustrate the pattern of nutrient uptake and partitioning as a percentage of final uptake based on combined data from the 2 sites in 2005

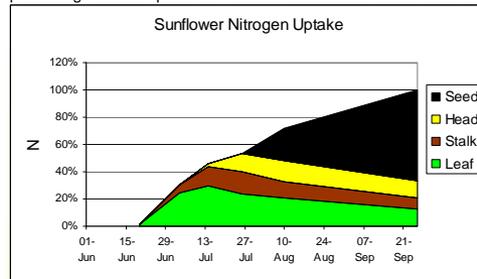


Figure 2. Nitrogen uptake in 2005.

Total N uptake was 183 and 89 lb N/ac at Treherne and Carman, respectively.

The C:N ratio was 20:1, 29:1, 85:1 and 25:1 for seed, head, stalk and leaf, respectively.

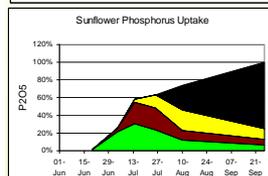


Figure 3. Phosphorus uptake in 2005.

Total P uptake was 65 and 42 lb P₂O₅/ac at Treherne and Carman, respectively. Most of the P translocated from the vegetative tissue to the grain.

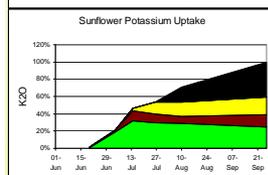


Figure 4. Potassium uptake in 2005.

Total K uptake was 300 and 126 lb K₂O/ac at Treherne and Carman, respectively. Most of the K remained in the crop residue.

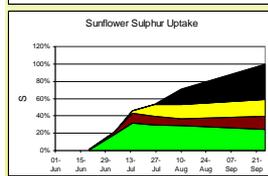


Figure 5. Sulphur uptake in 2005.

Total S uptake was 20 and 8.5 lb S/ac at Treherne and Carman, respectively. Most of the K remained in the crop residue and little translocated to the seed.

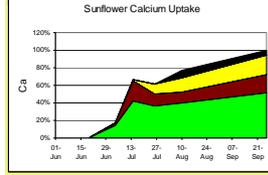


Figure 6. Calcium uptake in 2005.

Total Ca uptake was 103 and 68 lb Ca/ac at Treherne and Carman, respectively. Almost all of the Ca remained in the crop residue with no translocation to the seed.

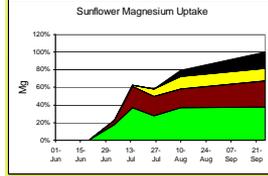


Figure 7. Magnesium uptake in 2005.

Total Mg uptake was 72 and 25 lb Mg/ac at Treherne and Carman, respectively. Most Mg remained in the crop residue with no translocation to the seed.

Biomass at Harvest and Nutrient Removal Values

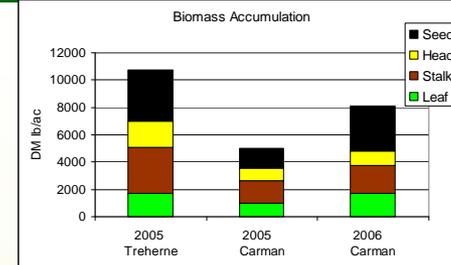


Figure 7. Harvest biomass of the 2005 and 2006 crops.

Average harvest index was 35% (% total biomass as seed) with 30% of the biomass as stalk, 19% as leaf and 16% as head.

In general the amount of nutrient taken up was proportional to the biomass produced. Nutrients are reported in Table 1 relative to the seed yield and these values are compared those adapted from the CFI's "Nutrient Uptake and Removal" charts for Western Canada¹ and PPI's "Plant Nutrient Uptake and Removal for NC Region Crops"².

Table 1. Nutrient uptake and removal in pounds per cwt of sunflower yield.

Nutrient	Manitoba		CFI ¹		PPI ²	
	Uptake	Remove	Uptake	Remove	Uptake	Remove
N	3.7-6.1	2.4-3.3	3.4-4.1	2.4-3.0	5.5	2.7
P ₂ O ₅	1.2-2.8	0.9-1.3	1.15-1.4	0.7-0.9	1.2	1.0
K ₂ O	7.5-8.6	0.9-1.3	1.7-2.2	0.55-0.65	5.0	0.9
S	0.39-0.58	0.17-0.22	0.4-0.45	0.2-0.25	0.85	0.25
Ca	2.7-4.7	0.15-0.23				
Mg	1.86-1.93	0.30-0.36				
Zn	0.004-0.006	0.002-0.004				
Mn	0.009-0.019	0.002				
Cu	0.001-0.004	0.0003-0.002				
B	0.015-0.155	0.002				
Fe	0.027-0.36	0.003-0.004				

Potassium uptake and removal values (bolded) were substantially greater in this study than the standard ranges, probably due to luxury consumption. Other major nutrient values generally fall within or close to the published range, although a yield discrepancy was detected in the CFI chart. The micronutrient values are shown but no standard values are available for comparison.

Summary

Nutrient uptake and removal values for sunflowers grown in Manitoba were similar to published guidelines, with the exception of much greater K uptake. The high C:N ratio of stalks contributes to their slow decomposition.

Acknowledgements

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References

1. Canadian Fertilizer Institute. 1998. Nutrient Uptake and Removal by Field Crops - Western Canada 1998.
2. Potash and Phosphate Institute. Plant Food Uptake and Removal for Northcentral Region Crops. Pocketcard