Nutrient Uptake in Buckwheat

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Background

Buckwheat, which is thought to have originated in the mountainous regions of China, is grown in many parts of the world and has long been consumed as human food and as livestock feed. Early settlers from Ukraine brought buckwheat to Manitoba where it was cultivated and used in traditional dishes, with any surplus buckwheat being fed to chickens. Manitoba has the most acres of buckwheat produced in Canada annually.

The buckwheat which is produced commercially in Manitoba is common buckwheat, Fagopyrum esculentum Moech. Tartary buckwheat, F. tataricum (L.) L. J. Gaertin, is a related species. It is considered a noxious weed in western Canada although it has been grown for feed in eastern Canada. More distantly related is wild buckwheat, Polygonum convolvulus L., which is a common weed. These related species and common buckwheat do not cross.

To better understand the nutrient uptake of buckwheat, this study was undertaken based on protocol developed for sequential sampling of various other crops and nutrient analysis to develop nutrient uptake curves.

Study site

This replicated and randomized trial was established at the Carberry Crop Diversification Center in 2021. It was seeded June 1st on cereal stubble pre-treated May 21st with a glyphosate/Heat mixture as a broad spectrum herbicide application to control all emerged weeds.

Nitrogen was applied at 45 lbs/a as a pre-seed broadcast application. An additional 15 lbs/a of sulphur was applied post seeding as a broadcast contributing another 10 lbs/a of nitrogen.

At seeding, the seedbed was firm and moist from recent rains. The variety Mancan was used for the trial seeded at 9.25 inches seed-row spacing. Emergence was rapid and uniform. 2021 was a dryer and warmer than normal season however the subsoil moisture reserves along with moderate regular rainfall events provided good growing conditions for the crop.

Results

Ten feet of the mid-row of each replicated plot (5 rows each) was sampled. After harvesting and separating the plant parts, the samples were oven dried for 5 to 7 days before weighing. Biomass was measured as dry samples were fresh out of the oven. Samples were bagged and kept in storage until sub-samples were prepared for lab analysis.

Dry matter weight (g) per 10 feet of mid-row at different stages:

	21-Jun	28-Jun	05-Jul	26-Jul	05-Aug	18-Aug	29-Sep
	2-leaf	5-leaf	Begin flower	Begin seed set	Begin seed fill	Mid seed set/fill	Full maturity
Stems		17.6	75.5	220.5	285.0	318.9	324.8
Fresh leaves	25.7	43.3	82.4	168.9	143.9	120.5	41.4
Dropped leaves							76.6
Flowers				8.8	45.5	50.9	76.6
Seed						23.7	201.1
Total	25.7	60.8	157.9	398.3	474.4	513.9	720.5
Growth rate g/d	1.3	5.0	13.9	11.4	7.6	3.0	4.9

Crop growth and development

June 7, the site was visited revealing good emergence of the crop.

June 14, the parcels were inspected to assess emergence and count plants for a plant density measurement. Emergence was even and uniform. Plant population was determined by counting one meter of seed row in three parcels: 57, 58 and 78.

June 21st, the two-leaf stage was reached for the first stage of plant sampling. Plants collected were laid to air dry.

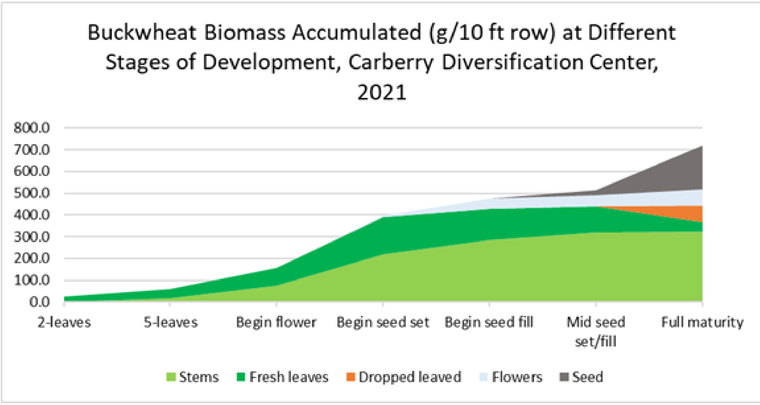
June 28th the stand reached the five-leaf stage of development for sampling.

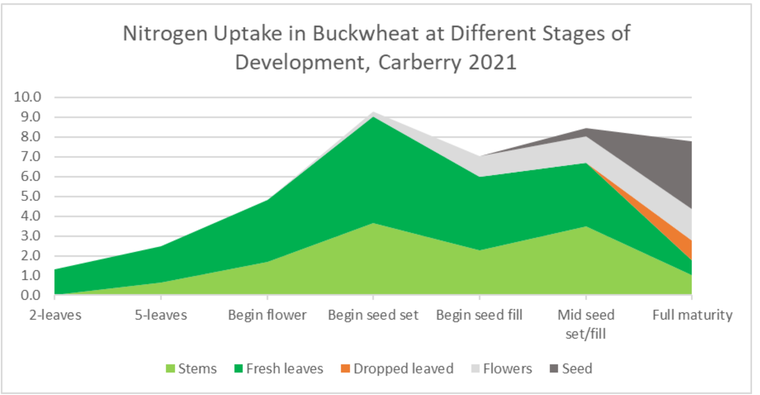
July 5th, the begin flower stage was reached. Whole plants were collected, parts separated into stems, leaves but flowers were just starting so not enough material to measure.

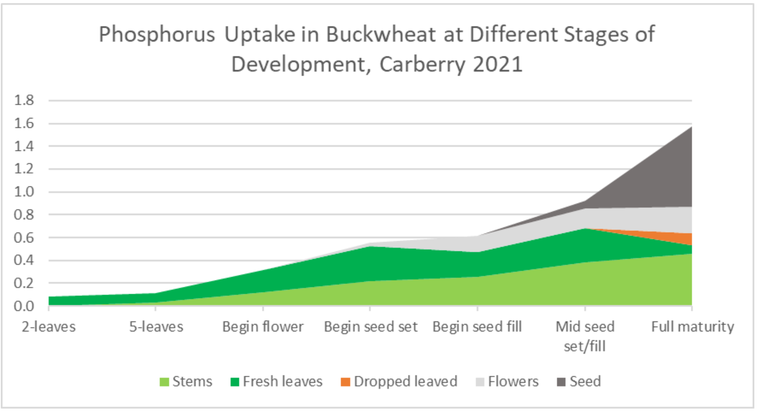
August 30, days after a substantial rainfall event, plants are flowering abundantly and seed fill is occurring. September 29th, full maturity, whole plant collected were separated into different parts.

Nutrient Analysis of various plant components and stage of development:

Field Id	Sample ID	Total-N	P	K	S	Ca	Mg	Na	Zn	Fe	Mn	Cu	B
		%	%	%	%	%	%	%	ppm	ppm	ppm	ppm	ppm
2 LEAF SAMPLING	WHOLE PLANTS	5.03	0.33	2.59	0.28	2.27	1.55	0.01	58	204	172	5	24
5 LEAF SAMPLING	STEMS	3.76	0.18	5.64	0.18	1.77	1.36	0.01	29	109	48	4	21
5 LEAF SAMPLING	LEAVES	4.18	0.19	2.33	0.26	3.32	2.07	0.01	59	265	233	5	23
BEGIN FLOWER	STEMS	2.24	0.16	4.86	0.14	1.23	1.15	0.01	20	68	49	3	18
BEGIN FLOWER	LEAVES	3.79	0.24	1.90	0.24	3.90	2.37	0.01	55	170	349	6	31
BEGIN SEED SET	STEMS	1.66	0.10	3.03	0.09	0.97	1.19	0.01	12	62	38	3	19
BEGIN SEED SET	LEAVES	3.19	0.18	1.63	0.21	3.78	2.48	0.01	37	167	292	6	36
BEGIN SEED SET	FLOWERS	2.84	0.34	1.49	0.17	1.57	1.02	0.01	36	126	124	9	60
BEGIN SEED FILL	STEMS	0.80	0.09	2.31	0.07	0.48	0.70	0.01	10	36	28	1	15
BEGIN SEED FILL	LEAVES	2.57	0.15	1.27	0.17	2.88	2.18	0.01	29	174	284	5	31
BEGIN SEED FILL	FLOWERS	2.33	0.32	1.41	0.16	0.98	0.94	0.01	31	125	111	9	26
MID SEED SET/FILL	STEMS	1.09	0.12	2.47	0.08	0.52	0.85	0.01	12	26	42	2	15
MID SEED SET/FILL	LEAVES	2.69	0.25	1.71	0.20	2.54	1.97	0.01	32	160	305	6	40
MID SEED SET/FILL	FLOWERS	2.57	0.33	1.33	0.17	0.96	0.85	0.01	33	141	126	10	30
MID SEED SET/FILL	SEEDS	1.76	0.30	0.56	0.13	0.07	0.25	0.01	22	29	22	8	11
FULL MATURITY	STEMS	0.32	0.14	2.54	0.08	0.58	0.64	0.01	9	27	56	1	14
FULL MATURITY	FRESH LEAVES	1.75	0.19	1.77	0.15	3.02	1.92	0.01	23	345	506	4	43
FULL MATURITY	DROPPED LEAVES	1.33	0.14	1.13	0.11	3.99	2.27	0.01	30	1675	559	3	32
FULL MATURITY	FLOWERS	2.08	0.30	1.46	0.16	1.41	0.84	0.01	48	469	203	8	36
FULL MATURITY	SEEDS	1.69	0.35	0.65	0.13	0.07	0.27	0.01	26	40	33	6	12







Summary

As expected, buckwheat biomass accumulates rapidly in its early development stages. For the most part, nutrient accumulation follows biomass accumulation as found in other similar nutrient uptake studies. Rapid plant growth observed confirms grower experience with buckwheat that, given a good start, even with limited weed control options in commercial production, buckwheat is able to compete well with weeds.

In this study, dry matter yield of vegetative plant parts, stems and leaves, is optimized at the begin seed set to the begin seed fill stage.

Macronutrients accumulate rapidly as the plants grow.

A large proportion of Nitrogen, Phosphorus and Sulphur end up in the seed.

Buckwheat is considered a good scavenger of soil phosphorus and this study shows that with very low starting phosphorus levels (2. ppm), the crop was able to yield well and accumulate much of the Phosphorus taken up by the plant into the seed.

Potassium and intermediate elements like Calcium and Magnesium tend to remain in the vegetative parts of the plants while micronutrients like zinc and copper accumulate in the seed.

See full report at:

https://mbdiversificationcentres.ca/wp-content/uploads/2022/04/2021_CMCDC-Annual-Report.pdf

Credits: Manitoba Agriculture and Carberry Crop Diversification Center staff